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Construction Engineering
Research Laboratory

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TECHNICAL REPORT P-86/05
May 1986
Engineer Unit Microcomputer Applications

Combat Engineer Mission Management Module (CEM^3), Volume II:

Engineer Task Algorithm Reference Guide for Version 86.0

by
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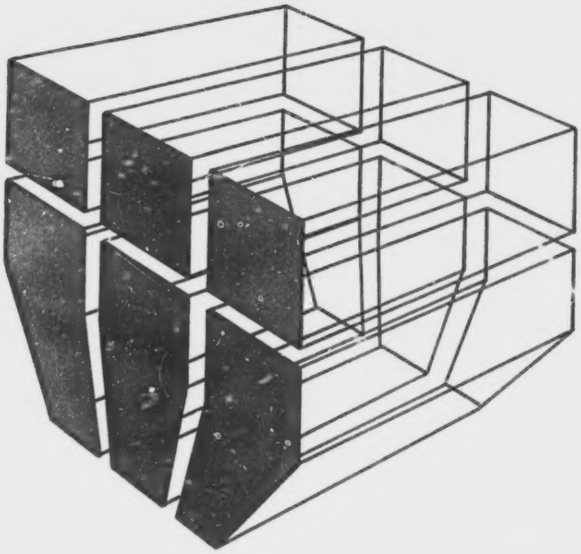

The Combat Engineer Mission Management Module (CEM^3) is a mission planning tool developed as a pilot program to determine engineer requirements for command and control software. The program contains algorithms for calculating resource requirements for many combat engineer tasks.

This report documents the assumptions, references, and algorithms used to develop the resource calculations in CEM^3. This information can be used to assess the CEM^3 calculations' accuracy. It describes the methods used to determine the resources needed for the most common engineer tasks and serves as a reference manual for engineer operations planning.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Combat Engineer Mission Management Module (CEM^3) is a mission planning tool developed as a pilot program to determine engineer requirements for command and control software. The program contains algorithms for calculating resource requirements for many combat engineer tasks.

This report documents the assumptions, references, and algorithms used to develop the resource calculations in CEM^3. This information can be used to assess the CEM^3
(Cont'd)

BLOCK 20 (Cont'd).

calculations' accuracy. It describes the methods used to determine the resources needed for the most common engineer tasks and serves as a reference manual for engineer operations planning.

FOREWORD

This investigation was conducted for the Assistant Chief of Engineers, Office of the Chief of Engineers (OCE), under Project 4A762731AT41, "Design, Construction, and Operation and Maintenance Technology for Military Facilities"; Task E, "Military Engineering"; Work Unit 038, "Engineer Unit Microcomputer Applications." The applicable STO is 81-5.1:1S. The OCE Technical Monitor was Dr. Clemens Meyer, DAEN-ZCM.

This work was performed by the Facilities Systems Division (FS) of the U.S. Army Construction Engineering Research Laboratory (USA-CERL). CPT Lynn Wahlgren made significant contributions to the development of CEM^3. E. A. Lotz is Chief of FS.

COL Paul J. Theuer is Commander and Director of USA-CERL, and Dr. L. R. Shaffer is Technical Director.

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LIST OF ABBREVIATIONS Abbrev-1

DISTRIBUTION

COMBAT ENGINEER MISSION MANAGEMENT MODULE (CEM^3), VOLUME II: ENGINEER TASK ALGORITHM REFERENCE GUIDE FOR VERSION 86.0

1 INTRODUCTION

Background

The Army is developing the Army Command and Control System (ACCS), a tactical, automated control system supporting military commanders from the foxhole through corps on the battlefield. The five major functional "nodes" of ACCS are: maneuver, fire support, air defense, intelligence and electronic warfare, and combat service support. The combat engineer function is a subordinate system to the maneuver control system.

The U.S. Army Construction Engineering Research Laboratory is developing functional requirements for the Combat Engineer Command and Control Subordinate System to the Maneuver Control System of the Tactical Army Command and Control System. Following an evolutionary development strategy, a microcomputer-based Combat Engineer Mission Management Module (CEM^3) has been developed as a pilot program to determine combat engineer requirements for command and control software. CEM^3 is a mission-planning tool that addresses the engineer staff's planning needs for corps through battalion. The program contains the algorithms to calculate resource requirements for many mobility, countermobility, and survivability tasks.

Purpose

The purpose of this work is to document the assumptions, references, and algorithms used to develop the resource calculations in CEM^3. CEM^3 users can investigate the assumptions and algorithms to verify the calculations' accuracy. This information will serve as a reference guide to the methods used in determining resources needed for the most common engineer tasks and to engineer operations planning.

Approach

To develop CEM^3, a list of the most common combat engineer tasks was compiled. U.S. Army Field Manuals, Technical Manuals and other sources were searched to determine the accepted methods of calculating resource requirements. The references, assumptions, equations, constants, and variables were documented and compiled to form the basis of the software.

Scope

The combat engineer tasks included in this report are limited to the ones used in CEM^3. In general, the tasks include those most often performed by combat engineers on the battlefield. Tasks involving tactical bridging, water supply, mapping, and terrain analysis were excluded from CEM^3 and therefore are not contained in this report.

Estimates in this report are for direct combat engineering effort. Indirect effort, including command and supervision, staff functions, support functions, and transportation between job sites, is not included in the estimates.

The manpower and equipment estimates concentrate on engineer squads and major items of engineer equipment. Major material items are also listed in the estimates; however, small items of equipment and material are not included, nor are equipment and vehicle operators. It is assumed an operator will be available for every piece of equipment or vehicle; if an operator is not available, the piece of equipment or vehicle is considered nonoperational.

Engineer tasks, major pieces of equipment, and resources included in this report are listed in Appendix A. Appendix B lists the numbers of different vehicles assumed to be assigned to maneuver units.

Finally, research was not conducted to validate the correctness of algorithms contained in the references.

Mode of Technology Transfer

This information will be distributed with all CEM^3 programs. CEM^3 will be tested at several engineer units and will be made available to other users through the Command and Control Microcomputer User's Group at Fort Leavenworth, KS.

2 ASSUMPTIONS

Overview

The purpose of these algorithms is to permit rapid estimates of manpower, equipment, and material early in engineer planning so that additional resources can be requisitioned early enough to ensure their availability when needed. The algorithms can be used for estimating the total effort required and for initially allocating tasks or units.

The figures provided are for preliminary planning only. When field reconnaissance has been made and precise tasks have been defined, exact manpower, equipment, and material requirements will be known. Resources can then be reallocated, if necessary.

Environmental conditions and tactical considerations defined for the European theater apply. Visibility and ground conditions are assumed to be favorable. Work rates are for work accomplished in good weather during daylight. It is assumed that there is no interference from enemy actions. In addition, manpower, equipment, and materials are assumed to be onsite and ready to start. CEM[3] allows you to input efficiency factors to account for actual conditions which vary from these assumptions. Efficiency rates for manpower and equipment should be decreased by 50 percent for nighttime and 20 percent for rainy weather. Additionally, efficiency rates should be reduced 15 percent for closed hatch operations with the M9 ACE.

Manpower Resources

Eight person squads are assumed for all squad hour computations. It is assumed that vehicle operators perform vehicle maintenance and miscellaneous transportation functions while they are at the job site. Vehicle operators are not included in the manpower estimates.

Job site security requirements are assumed to be minimal, so that additional manpower resources dedicated to security are not included in the estimates. The estimates also do not quantify manpower required for obstacle maintenance or guarding.

Equipment Resources

It is assumed that equipment will not have maintenance problems. Reliability, Availability, and Maintainability (RAM) factors therefore were not considered when computing task durations.

Differences in the performance characteristics of various equipment models or manufacturers are assumed to be small. Commitment of a D7 dozer results in the simultaneous commitment of a M916 tractor with trailer. Other types of engineer equipment are assumed to convoy to the job site at low speed.

Blade hours include dozer, armored combat earthmover (ACE), combat engineer vehicle (CEV), small emplacement excavator (SEE), and scoop loader hours. Graders do not contribute to blade hours. While CEVs are included as blade hours, it is not recommended that they be used for digging survivability positions.

3 ENGINEER TASK ALGORITHMS

Initial Estimate

The initial estimates given in Appendices C through E for mobility, countermobility, and survivability tasks provide gross predictions for effort and resource requirements. Manpower requirements are given in squad hours. Equipment requirements are given in blade hours. Material requirements are given as total weight in metric tons.

Detailed Estimate

The detailed estimates given in Appendices F through H for mobility, countermobility, and survivability tasks provide more refined predictions than those for the same tasks in the initial estimates. Manpower requirements are listed in squad hours as in the initial estimate; however, equipment requirements are given in hour requirements for major pieces of engineer equipment, and material requirements list specific materials required as well as the requirements in total weight (metric tons).

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FM 100-5, *Operations* (U.S. Department of the Army, August 1982).

FM 101-5, *Staff Officers' Field Manual, Staff Organization and Procedure* (U.S. Department of the Army, May 1984).

FM 101-5-1, *Operational Terms and Graphics* (U.S. Department of the Army, March 1980)

FM 101-10-1, *Staff Officers' Field Manual, Organizational, Technical, and Logistic Data* (U.S. Department of the Army, July 1976).

RF 101-999, *Staff Officers' Handbook* (U.S. Army Command and General Staff College, 1983).

APPENDIX A:

TASKS, EQUIPMENT, AND RESOURCES

Mobility Tasks

1. Repair and maintain MSR* (two-lane bituminous)
2. Repair and maintain unpaved secondary road (two-lane)
3. Repair and maintain unpaved combat road (one-lane)
4. Construct unpaved secondary road (Class C)
5. Construct combat trail
6. Reduce dry gap for vehicle passage
7. Construct temporary ford site
8. Conduct hasty assault minefield breach
9. Breach antitank ditch
10. Breach road crater
11. Breach abatis
12. Breach wire obstacle
13. Breach road block
14. Assault crossing with AVLB (0 to 17 m, Class 60).

Countermobility Tasks

1. RCD--deliberate road crater
2. RCH--hasty road crater
3. RCM--road crater with M180
4. RCR--relieved face road crater
5. BRA--blow major four-lane highway bridge
6. BRB--blow primary highway bridge
7. BRC--blow secondary two-lane highway bridge
8. ABT--abatis
9. ATD--antitank ditch
10. WBT--general-purpose barbed-tape obstacle
11. WTC--triple standard concertina
12. WRC--nonstandard concertina roadblock
13. MFAT--RAAMS artillery delivered AT minefield
14. MFAP--ADAM artillery delivered AP minefield
15. MFGT--minefield, GEMSS, AT only
16. MFGP--minefield, GEMSS, AP only
17. MFGM--minefield, GEMSS, mixed AT and AP
18. MFMT--minefield, MOPMS, AT
19. MFMP--minefield, MOPMS, AP
20. MFH--M56 helicopter delivered AT mines
21. MFAF--GATOR, USAF delivered scatterable mines
22. MFD--M57 AT mine dispensing system
23. MFJ--standard minefield, density .5-.5-0
24. MFK--standard minefield, density 1-1-1.

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*The List of Abbreviations explains acronyms used in Appendices A through H.

Survivability Tasks

1. Protective Position, M1/M60 Tank
2. Protective Position, M2/M3 Fighting Vehicle
3. Protective Position, M113 Series Carrier
4. Protective Position, Howitzer, Self Propelled
5. Protective Position, Howitzer, Towed
6. Protective Position, M577 Command Post
7. Protective Position, Noncombat Vehicle
8. Berm for CHAPARRAL
9. Berm for FAAR
10. Berm for CB/CM Radar (FA)
11. Berm for HAWK Launcher
12. Berm for Info Coordination Center (HAWK)
13. Berm for PAR/ROD/CWAR/HIPIR (HAWK)
14. Berm for Generator (HAWK)
15. Cut Slot for BATTERY CONTROL (HAWK)
16. Cut Slot for PLT CP (HAWK)
17. Construct Vehicle Trench (Communications)
18. Construct Shelters for Command & Commo Facilities

Dig in a maneuver unit with the following TOEs:

19. ANTIARMOR CO, INF BN (M) ITV, 01OCT82, 07248J400
20. ARMD CAV REGT, 01APR84, 17051J330
21. ARMD CAV REGT, E/W M1/M3, 01APR84, 17051J320
22. ARMD CAV REGT, W/M60/M113/ITV, 01APR84, 17051J320
23. ARMD CAV SQDN, ARMD CAV REGT, 01APR84, 17055J330
24. ARMD CAV SQDN, ARMD CAV REGT, 01APR84, 17055J310
25. ARMD CAV SQDN, ACR, M1/M3, 01APR84, 17055J320
26. ARMD CAV TRP, ARMD CAV REGT, 30NOV70, 17058H000
27. ARMD CAV TRP, ARMD CAV REGT, 30NOV70, 17058H020
28. ARMD CAV TRP, AC SQDN, M113/M60, 01APR84, 17057J310
29. ARMD CAV TRP, AC SQDN, M1/M3, 01APR84, 17057J320
30. CSC, INF BN (MECH), W/106, 30NOV70, 07048H010
31. CSC, INF BN MECH-18 TOW, 30NOV70, 07048H030
32. CSC, INF BN MECH-12 TOW, 30NOV70, 07048H020
33. FA BN, 105-mm T, INF DIV, 20APR79, 06155H000
34. FA BN, 155 SP HVY DIV, 01OCT82, 06365J410
35. FA BN, 155 SP HVY DIV, 01OCT82, 06365J420
36. FA BN, 155 SP HVY DIV, 01OCT82, 06365J430
37. FA BN, 155-mm/8-in., INF DIV, 20APR79, 06165H000
38. FA BN, 8 in./MLRS HVY DIV, 01OCT82, 06395J200
39. FA BTRY, 155 SP HVY DIV, 01OCT82, 06367J410
40. FA BTRY, 155-mm T, FA BN, 09AUG78, 06167H000
41. FA BTRY, 8-in. SP HVY DIV, 01OCT82, 06397J200
42. FA BTRY, FA BN, 8-in. SP, 09AUG78, 06358H000
43. HHB 8-in./MLRS BN HVY DIV, 01OCT82, 06396J200
44. HHB, 155 T/8-in. SP, FA BN, 20APR79, 06166H000
45. HHB, FA BN, 105-mm TOWED, 20APR79, 06156H000
46. HHB, FA BN, 105-mm TOWED, 09AUG78, 06157H000
47. HHB, FA BN, 155 SP HVY DIV, 01OCT82, 06366J410
48. HHB, FA BN, 155 SP HVY DIV, 01OCT82, 06366J420
49. HHB, FA BN, 155 SP HVY DIV, 01OCT82, 06366J430

50. HHC, INF BN (MECH), 30NOV70, 07046H010
51. HHC, INF BN (MECH), 30NOV70, 07046H020
52. HHC, INF BN MECH BFVS, 01APR83, 07246J410
53. HHC, INF BN MECH M113, 01APR83, 07246J420
54. HHC, TK BN, M60, 01OCT81, 17236J1110
55. HHT, ARMD CAV REGT, 01APR84, 17052J310
56. HHT, ARMD CAV REGT, 01APR84, 17052J320
57. HHT, ARMD CAV SQDN, 01APR84, 17056J310
58. HHT, ARMD CAV SQDN, 01APR84, 17056J329
59. HHT, ARMD CAV SQDN, 01APR84, 17056J330
60. INF BN (MECH) E/W 106, 30NOV70, 07045H010
61. INF BN E/W 12 TOW, 30NOV70, 07045H020
62. INF BN E/W 18 TOW, 30NOV70, 07045H030
63. INF BN-MECH E/W BFVS, 01APR83, 07245J410
64. INF BN-MECH E/W M113, 01APR83, 07245J420
65. RIFLE CO, INF BN MECH M113, 01OCT82, 07247J420
66. RIFLE CO, INF BN, (MECH), 30NOV70, 07047H010
67. RIFLE CO, INF BN, (MECH), 30NOV70, 07047H020
68. RIFLE CO, INF BN, MECH BFVS, 01OCT82, 07247J410
69. SVC BTRY, 155 SP HVY DIV, 01OCT82, 06369J410
70. SVC BTRY, 155-mm T/8-in. SP, 30NOV70, 06169H000
71. SVC BTRY, 8 in./MLRS HVY DIV, 01OCT82, 06399J200
72. SVC BTRY, FA BN, 105-mm TOWED, 20APR79, 06159H000
73. TK BN, EQ W/M1, 01APR84, 17235J420
74. TK BN, EQ/W M60, 01APR84, 17235J410
75. TK CO, (M1), 01APR84, 17237J420
76. TK CO, TK BN M60, 01APR84, 17237J410

Resources Tracked for Initial Estimate

1. Combat engineer squad hours
2. Blade hours
3. GEMSS hours
4. M57 minelayer hours
5. M56 helicopter sorties
6. Artillery rounds--AT
7. Artillery rounds--AP
8. GATOR canisters
9. Total logistic weight (MT)

Resources Tracked for Detailed Estimate

Manpower

Combat engineer squads (hrs)

Equipment

2.5 CY scoop loader (HRS)
2.5-ton truck (HRS)
5-ton dump truck (HRS)
5-ton truck (HRS)
10-ton steel wheel roler (HRS)

M916 tractor/trailer (HRS)
13-wheel pneumatic roller (HRS)
M-9 armored combat earthmover (ACE) (HRS)
Air compressor (250 CFM) (HRS)
JD410/Auger (HRS)
Armored vehicle launched bridge (AVLB) (HRS)
Bitum kettle (HRS)
Small emplacement excavator (SEE) (HRS)
Combat engineer vehicle (CEV) (HRS)
Crane (HRS)
T5 dozer (HRS)
D7 dozer (HRS)
M-128 ground emplaced mine system (GEMSS) (HRS)
Graders (HRS)
M-57 antitank mine dispensing system (HRS)
Truck-mounted water distributors (HRS)
Vibratory roller (HRS)
Water distributors (towed) (HRS)
Chainsaw (EA) HRS)
M548 cargo (HRS)
D8 dozer (HRS)
Scraper (HRS)
MK122 MICLIC launcher (HRS)

Logistics

Expendables (nonexplosives)

Aggregate (CY)
Aluminum shelter kit (EA)
Asphalt (55-gal drum)
Barbed tape (REELS)
Barbed tape concertina (COILS)
Culvert (METERS)
GP barbed tape obstacle (GPBTO) packages (EA)
Long pickets (EA)
Short pickets (EA)

Expendables (explosive)

Detonating cord (METERS)
Electric blasting caps (EA)
M-60 fuse igniters (EA)
Non-electric blasting cap (EA)
M-700 time fuse (METERS)
C-4 (KG)
CEV rounds (EA)
Cratering charges (18KG/40LB) (EA)
M-14 APB mines (EA)
M-15 AT mines (EA)
M-16 APF mines (EA)
M-21 AT mines (EA)
M-180 cratering kits (EA)
M173 kits (EA)

M1A1 bangalore torpedo (EA)
M3 shape charges (18KG/40LB) (EA)
MICLIC - M58A3 line charge, MK22 rocket (EA)
TNT (KG)
M-74 AP mines (GEMSS) (EA)
M-75 AT mines (GEMSS) (EA)
XM-131 MOPMS AP packs (EA)
XM-132 MOPMS AT packs (EA)

Nonengineer Resources

M67/M72 AP - Artillery rounds (ADAM) (EA)
M70/M73 AT - Artillery rounds (RAAM) (EA)
GATOR cannisters (EA)
M56 helicopter sorties (EA)

APPENDIX B:

NUMBER OF VEHICLES ASSIGNED TO MANEUVER UNITS

TOE NUMBER	WEAPON SYSTEMS					SUPPORT VEHICLES	
	M1/M60 Tanks	M2/M3 Fighting Vehicle	M133 Series Carrier	ARTILLERY		M577 CP Carrier	NonCombat Vehicle
				Howitzer SP	Howitzer Towed		
07248J400	0	0	16	0	0	0	3
17051J330	123	0	240	24	0	52	837
17051J320	120	0	127	18	0	36	721
17051J310	0	0	203	18	0	39	779
17055J330	41	0	55	0	0	9	70
17055J310	43	0	65	6	0	11	111
17055J320	41	0	29	6	0	0	94
17058H000	0	0	0	0	0	0	17
17058H020	0	0	0	0	0	0	20
17057J310	9	0	17	0	0	1	5
17057J320	9	0	17	0	0	1	4
07048H010	0	0	19	0	0	1	17
07048H030	0	0	37	0	0	1	3
07048H020	0	0	28	0	0	1	8
06155H000	0	0	0	0	18	0	115
06365J410	0	0	13	24	0	13	142
06365J420	0	0	13	24	0	13	133
06365J430	0	0	17	24	0	14	143
06165H000	0	0	6	22	0	3	123
06395J200	0	0	0	12	0	11	126
06367J410	0	0	0	8	0	2	15
06167H000	0	0	0	6	0	0	16
06397J200	0	0	0	6	0	2	14
06358H000	0	0	0	4	0	1	15
06396J200	0	0	0	0	0	3	11

TOE NUMBER	WEAPON SYSTEMS			ARTILLERY		SUPPORT VEHICLES	
	M1/M60 Tanks	M2/M3 Fighting Vehicle	M133 Series Carrier	Howitzer SP	Howitzer Towed	M577 CP Carrier	NonCombat Vehicle
06166H000	0	0	6	0	0	2	35
06156H000	0	0	0	0	0	0	52
06157H000	0	0	0	0	6	0	14
06366J410	0	0	15	0	0	7	33
06366J420	0	0	13	0	0	7	32
06366J430	0	0	17	0	0	8	34
07046H010	0	0	6	0	0	5	68
07046H020	0	0	6	0	0	5	63
07246J410	0	0	27	0	0	7	80
07246J420	0	0	31	0	0	7	78
17236J110	2	0	29	0	0	8	64
17052J310	0	0	3	0	0	5	60
17052J320	0	0	3	0	0	4	33
17056J310	2	0	9	0	0	7	69
17056J320	0	0	11	0	0	6	70
17056J330	0	0	9	0	0	6	60
07045H010	0	0	82	0	0	6	125
07045H020	0	0	113	0	0	6	72
07045H030	0	0	111	0	0	6	93
07245J410	0	0	107	0	0	8	108
07245J420	0	0	111	0	0	7	86
07247J420	0	0	16	0	0	0	3
07047H010	0	0	22	0	0	0	7
07047H020	0	0	22	0	0	0	8
07247J410	0	0	14	0	0	0	3
06369J410	0	0	0	0	0	0	40
06169H000	0	0	0	0	0	0	27
06399J200	0	0	0	0	0	0	32
06159H000	0	0	0	0	0	0	21
17235J420	58	0	29	0	0	8	88
17235J410	58	0	29	0	0	8	82
17237J420	14	0	0	0	0	0	3
17237J410	14	0	0	0	0	0	4

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APPENDIX C:

RESOURCE REQUIREMENTS FOR MOBILITY TASKS—INITIAL ESTIMATE

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1. Repair and maintain MSR (two-lane bituminous.[1])

   a. Required information: MSR length (km); duration (days) the MSR will be repaired and maintained.

   b. Resource requirements per kilometer for 5 days:

      (1) Squad hr: 0.6.

      (2) Blade hr: none.

      (3) Total logistical weight: 0.08 MT.

   c. Description: MSR is assumed to be a two-lane, bituminous surface road on which there is two-way traffic.

   d. Additional information: it is assumed that aggregate is procured locally and that the asphalt is provided by assets located outside of the unit maintaining the MSR. The scoop loader is assumed to be organic to the asphalt production plant.

2. Repair and maintain an unpaved secondary road (two-lane Class D).[2]

   a. Required information: unpaved secondary road length (km); duration (days) the road will be repaired and maintained.

   b. Resource requirements per kilometer for 5 days:

      (1) Squad hr: 0.6.

      (2) Blade hr: 0.3.

      (3) Total weight: 0.01 MT.

   c. Description: it is assumed that the roads are average Class D, two-lane, graded and drained earth type over average rolling terrain and moderate rock.

   d. Additional information: dump trucks are used as tow vehicles for water distributors. The compactor and scoop loader are required for major road failures. It is assumed that aggregate is procured locally.

3. Repair and maintain an unpaved one-lane combat road.[3]

   a. Required information: combat road length (km); duration (days) the combat road will be repaired and maintained.

   b. Resource requirements per kilometer for 5 days:

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[1] *Combat Developments Engineer Family of Systems Study (EFOSS)*, Vol. VIII, App. N, "Engineer Systems Data Base (U.S. Army Engineer School, February 1979), pp N-III-CC-1 through N-III-CC-4; Technical Manual (TM) 5-303, Army Facilities Components System--Logistic Data and Bills of Materiel (HQDA, March 1982).

[2] *EFOSS*, pp N-III-dd-1 through N-III-dd-5; TM 5-303, p 1319.

[3] *EFOSS*, pp N-III-ee-1 through N-III-ee-5; TM 5-303, p 1300.

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(1) Squad hr: 0.6.

(2) Blade hr: 0.3.

(3) Total logistical weight: 0.01 MT.

c. Description: road is assumed to be an average Class D, single-lane, graded and drained earth type over rolling terrain with moderate rock.

d. Additional information: it is assumed that maintenance of the combat road does not require water distributors and that a scoop loader is used to load aggregate for patching badly worn areas. It is also assumed that aggregate is procured locally.

4. Construct an unpaved secondary road, Class C (two-lane).[4]

a. Required information: Class C road distance (km).

b. Resource requirements per kilometer using one of two classes of equipment:

(1) D7 dozer, ACE, or CEV with a 2.5 cu yd scoop loader

(a) Squad hr: 220.0.

(b) Blade hr: 1125.0.

(c) Total logistical weight: 0.50 MT.

(2) T5 dozer with a 2.5 cu yd scoop loader

(a) Squad hr: 220.0.

(b) Blade hr: 1687.5.

(c) Total logistical weight: 0.50 MT.

c. Description: road is average Class C and over rolling terrain, average woodland vegetation and moderate rock. Estimate includes construction of drainage ditches and culverts, but not bridges.

d. Additional information: one ACE or CEV can be substituted for one D7 dozer and one M916 tractor with trailer. It is assumed that aggregate is procured locally.

5. Construct a combat trail.[5]

a. Required information: combat trail distance (km).

b. Resource requirements per kilometer using one of two classes of equipment:

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[4] *EFOSS*, pp N-III-ff-1 through N-III-ff-7; TM 5-303, p 1300.
[5] *EFOSS*, pp N-III-gg-1 through N-III-gg-5.

(1) D7 dozer, ACE, or CEV

(a) Squad hr: 14.2.

(b) Blade hr: 11.4.

(c) Total logistical weight: none.

(2) T5 dozer

(a) Squad hr: 14.2.

(b) Blade hr: 17.1.

(c) Total logistical weight: none.

c. Description: the combat trail is designed to allow passage of tracked vehicles and most wheeled vehicles. Width is therefore approximately 4 m. Only impassible obstacles will be removed. The natural cover will be disturbed as little as possible.

d. Additional information: it is assumed that no hauling of fill or surface material is required; however, ravines and steep hills occasionally will require fill or cut capability. Trees are assumed to have diameters of 15 to 20 cm and 3 m spacing. This results in one tree per 3 m of trail that must be cut and removed. It is assumed that 20 m^3 cut and 20 m^3 fill are required per 100 m of trail. One ACE or one CEV may be substituted for one D7 dozer and one M916 tractor with trailer.

6. Reduce a dry gap bank grade for vehicle passage.[6]

a. Required information: number of dry gaps.

b. Resource requirements per dry gap using one of two classes of equipment:

(1) D7 dozer, ACE, or CEV

(a) Squad hr: none.

(b) Blade hr: 1.0.

(c) Total logistical weight: none.

(2) T5 dozer

(a) Squad hr: none.

(b) Blade hr: 1.5.

(c) Total logistical weight: none.

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[6] *EFOSS*, pp N-III-hh-1 through N-III-hh-5.

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c. Description: the work consists of cutting single-lane approaches through steep banks to provide access into and egress from a dry streambed or streambed containing a shallow, fordable stream.

d. Additional information: assumptions are that dry weather and average soil conditions prevail. There are no large trees on banks and ground is level above steep banks. Steep banks are 2 m above streambed. Earth excavated from uproad will be spread or piled in the streambed. The streambed is stable for traffic. One ACE or CEV may be substituted for one D7 dozer and one M916 tractor with trailer.

7. Construct a temporary ford site.[7]

   a. Required information: number of ford sites.

   b. Resource requirements per ford site using one of two classes of equipment:

      (1) D7 dozer, ACE, or CEV with a 2.5 cu yd scoop loader

         (a) Squad hr: 0.8.

         (b) Blade hr: 6.5.

         (c) Total logistical weight: none.

      (2) T5 dozer with a 2.5 cu yd scoop loader

         (a) Squad hr: 0.8.

         (b) Blade hr: 9.8.

         (c) Total logistical weight: none.

   c. Description: work consists of cutting single-lane approaches through steep banks on both sides of the streambed, stabilizing the approaches and the streambed with coarse aggregate, and marking the approaches and ford for vehicle drivers.

   d. Additional information: assumptions are as follows: the stream width is 10 m. Exposed stream bottom is approximately 4 m wide on each side of stream and will require stabilization. Stream is no more than 0.75 m deep and velocity is less than 1 m/sec. Bank is 2 m high. Both approaches and stream bottom require stabilization. Aggregate is 20 cm deep for approaches and exposed stream bottom and 30 cm deep for the ford. Aggregate is 3.5 m wide on the approaches and 5 m wide in the ford.

8. Conduct a hasty assault minefield breach.[8]

   a. Required information: total meters of minefield, method of breach, location.

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[7] *EFOSS*, pp N-III-ii-1 through N-III-ii-7.

[8] *EFOSS*, pp N-III-jj-1 through N-III-jj-7; *Combat Engineer Systems Handbook*, U.S. Army Engineer Center and School, Ft. Belvoir, VA, April 1985, p 21; FM 5-101, p B-2.

b. Resource requirements per breach using one of the following two methods:

(1) M173 charge per 70 m

(a) Squad hr: none.

(b) Blade hr: 1.0.

(c) Total logistical weight: 1.40 MT.

(2) MICLIC per 100 m.

(a) Squad hr: none.

(b) Blade hr: none.

(c) Total logistical weight: 1.60 MT.

c. Description: breach in lane 5 m (4.6 m for M173) wide in an antitank minefield my methods requiring the least possible planning and preparation.

d. Additional information: assume the minefield trace was located previously. Effort described is for a single-lane 100-m long for MICLIC and 70-m long for M173. Effort for breach of more than one lane can be calculated by taking multiples of the effort for a single lane. A second MICLIC may be fired from the breached lane if a longer breach is required. After firing the empty trailer may be used to draw another rocket and line charge.

9. Breach antitank ditch.[9]

a. Required information: number of antitank ditches, method used, and length of time AVLB will be in place if used.

b. Resource requirements per breach using one of the following four methods:

(1) D7 dozer, ACE, or CEV

(a) Squad hr: none.

(b) Blade hr: 0.1.

(c) Total logistical weight: none.

(2) T5 dozer

(a) Squad hr: none.

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[9] *Quantification of Mobility-Countermobility-Survivability Operations*, Memorandum for Record (USAES, 12 June 1981).

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(b) Blade hr: 0.2.

(c) Total logistical weight: none.

(3) 2.5-cu yd scoop loader

(a) Squad hr: none.

(b) Blade hr: 0.1.

(c) Total logistical weight: none.

(4) AVLB

(a) Squad hr: none.

(b) Blade hr: none.

(c) Total logistical weight: none.

c. Description: breach antitank ditch to allow passage of vehicles.

d. Additional information: none.

10. Breach road crater.[10]

a. Required information: number of road craters, method used, and length of time AVLB will be in place if used.

b. Resource requirements per breach using one of the following four methods:

(1) D7 dozer, ACE, or CEV

(a) Squad hr: none.

(b) Blade hr: 0.1.

(c) Total logistical weight: none.

(2) T5 dozer

(a) Squad hr: none.

(b) Blade hr: 0.2.

(c) Total logistical weight: none.

(3) 2.5-cu yd scoop loader

(a) Squad hr: none.

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[10] *Quantification of Mobility-Countermobility-Survivability Operations.*

(b) Blade hr: 0.1.

(c) Total logistical weight: none.

(4) AVLB

(a) Squad hr: none.

(b) Blade hr: none.

(c) Total logistical weight: none.

11. Breach abatis.[11]

a. Required information: number of abatis (100 m) and method used.

b. Resource requirements per breach using one of the following six methods:

(1) D7 dozer or ACE

(a) Squad hr: none.

(b) Blade hr: 0.1.

(c) Total logistical weight: none.

(2) CEV

(a) Squad hr: none.

(b) Blade hr: 0.3.

(b) Blade hr: 0.21 MT.

(3) T5 dozer

(a) Squad hr: none.

(b) Blade hr: 1.5.

(c) Total logistical weight: none.

(4) Handtools

(a) Squad hr: 24.0.

(b) Blade hr: none.

(c) Total logistical weight: none.

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[11] *Quantification of Mobility-Countermobility-Survivability Operations.*

(5) Chainsaws

(a) Squad hr: 2.0.

(b) Blade hr: none.

(c) Total logistical weight: none.

(6) Explosives

(a) Squad hr: 1.0.

(b) Blade hr: none.

(c) Total logistical weight: 0.16 MT.

c. Description: breach an abatis to allow vehicle passage.

d. Additional information = none.

12. Breach wire obstacle.[12]

a. Required information: number of wire obstacles and method used.

b. Resource requirements per obstacle using one of the following three methods:

(1) CEV

(a) Squad hr: none.

(b) Blade hr: 0.1.

(c) Total logistical weight: 0.08 MT.

(2) Handtools

(a) Squad hr: 0.1.

(b) Blade hr: none.

(c) Total logistical weight: none.

(3) Bangalore

(a) Squad hr: 0.1.

(b) Blade hr: none.

(c) Total logistical weight: 0.12 MT.

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[12] *Quantification of Mobility-Countermobility-Survivability Operations.*

c. Description: breach a wire obstacle; breached area is 0.6 m by 20 m.

d. Additional information: none.

13. Breach roadblock.[13]

a. Required information: number of roadblocks and method used.

b. Resource requirements per roadblock using one of the following four methods:

(1) D7 dozer or ACE

(a) Squad hr: none.

(b) Blade hr: 0.3.

(c) Total logistical weight: none.

(2) CEV

(a) Squad hr: none.

(b) Blade hr: 0.1.

(c) Total logistical weight: 0.08 MT.

(3) T5 dozer

(a) Squad hr: none.

(b) Blade hr: 0.5.

(c) Total logistical weight: none.

(4) Explosives and handtools

(a) Squad hr: 0.3.

(b) Blade hr: none.

(c) Total logistical weight: 0.04 MT.

c. Description: breach roadblock to allow passage of vehicles.

d. Additional information: none.

14. Make assault crossing.[14]

a. Required information: number of assault crossings and length of time the AVLBs are to be in place.

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[13] *Quantification of Mobility-Countermobility-Survivability Operations.*
[14] *Quantification of Mobility-Countermobility-Survivability Operations.*

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b. Resource requirements per crossing:

  (1) Squad hr: none.

  (2) Blade hr: none.

  (3) Total logistical weight: none.

c. Description: use an AVLB to make an assault crossing.

d. Additional information: none.

APPENDIX D:

RESOURCE REQUIREMENTS FOR COUNTERMOBILITY TASKS—INITIAL ESTIMATE

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1. RCD--deliberate road crater.[15]
    - a. Required information: number of RCDs.
    - b. Resource requirements per RCD using cratering charges and one of the following four methods:
        - (1) Shaped charges w/mines
            - (a) Squad hr: 2.0.
            - (b) Blade hr: none.
            - (c) Total logistical weight: 0.45 MT.
        - (2) Shaped charges wo/mines
            - (a) Squad hr: 1.5.
            - (b) Blade hr: none.
            - (c) Total logistical weight: 0.38 MT.
        - (3) Auger w/mines
            - (a) Squad hr: 3.5.
            - (b) Blade hr: none.
            - (c) Total logistical weight: 0.31 MT.
        - (4) Auger wo/mines
            - (a) Squad hr: 3.0.
            - (b) Blade hr: none.
            - (c) Total logistical weight: 0.24 MT.
    - c. Description: approximately 12.2 m end to end, 7.6 m wide, 2.4 m deep, V-shaped.
    - d. Additional information: road is 7.6 m wide with 2.4-m shoulders on each side.
2. RCH--hasty road crater.[16]
    - a. Required information: number of RCHs.

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[15] Field Manual (FM) 5-102, *Countermobility* (Headquarters, U.S. Department of the Army [HQDA], March 1985), p 108,191; *EFOSS*, pp N-III-g-1 through N-III-g-10; *Quantification of Mobility-Countermobility-Survivability Operations.*

[16] FM 5-102, p 108, 191; *EFOSS*, pp N-III-g-1 through N-III-g-10; *Quantification of Mobility-Countermobility-Survivability Operations.*

b. Resource requirements per RCD using cratering charges and one of the following four methods:

(1) Shaped charges w/mines

(a) Squad hr: 2.0.

(b) Blade hr: none.

(c) Total logistical weight: 0.38 MT.

(2) Shaped charges wo/mines

(a) Squad hr: 1.5.

(b) Blade hr: none.

(c) Total logistical weight: 0.31 MT.

(3) Auger w/mines

(a) Squad hr: 3.5.

(b) Blade hr: none.

(c) Total logistical weight: 0.24 MT.

(4) Auger wo/mines

(a) Squad hr: 3.0.

(b) Blade hr: none.

(c) Total logistical weight: 0.17 MT.

c. Description: approximately 12.2 m end to end, 6.1 to 7.6 m wide, 1.8 to 2.1 m deep, V-shaped.

d. Additional information: road is 7.6 m wide with 2.4-m shoulders on each side.

3. RCM--road crater with M180.[17]

a. Required information: number of RCMs.

b. Resource requirements per RCD using M180 cratering charges either with mines or without mines:

(1) w/mines

(a) Squad hr: 1.0.

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[17] FM 5-102, p 108, 191; *EFOSS*, pp N-III-g-1 through N-III-g-10; *Quantification of Mobility-Countermobility-Survivability Operations.*

(b) Blade hr: none.

(c) Total logistical weight: 0.45 MT.

(2) wo/mines

(a) Squad hr: 0.5.

(b) Blade hr: none.

(c) Total logistical weight: 0.38 MT.

c. Description: relieved faced 9.1 m long, 5.5 m wide, and 2.4 m deep.

d. Additional information: blasting cap machine required.

4. RCR--relieved face road crater.[18]

a. Required information: number of RCRs.

b. Resource requirements per RCR using cratering charges and one of the following four methods:

(1) Shaped charges w/mines

(a) Squad hr: 2.5.

(b) Blade hr: none.

(c) Total logistical weight: 0.47 MT.

(2) Shaped charges wo/mines

(a) Squad hr: 2.0.

(b) Blade hr: none.

(c) Total logistical weight: 0.40 MT.

(3) Auger w/mines

(a) Squad hr: 4.5.

(b) Blade hr: none.

(c) Total logistical weight: 0.28 MT.

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[18] FM 5-102, p 108, 191; *EFOSS*, pp N-III-g-1 through N-III-g-10; *Quantification of Mobility-Countermobility-Survivability Operations.*

(4) Auger wo/mines

(a) Squad hr: 4.0.

(b) Blade hr: none.

(c) Total logistical weight: 0.21 MT.

c. Description: approximately 12.2 m end to end, 7.6 to 9.1-m wide, 2.1-m deep, trapezoidal-shaped with unequal side slopes.

d. Additional information: road width is 7.6 m with 2.4 m shoulders on each side. Two rows of charges 2.4 m apart. The holes in the row on the friendly side are spaced 2.1 m and are 1.5 m deep filled with 18.2 kg (40 lb) cratering charges. The holes in the row on the enemy side are staggered in relation to the friendly row and are 1.2-m deep with 21.9-kg of TNT. The cratering charges are dual-primed with 0.5 kg blocks of TNT. A more effective crater can be created using electrical primed charges with a 1 - 1+ second delay in firing the friendly side row of cratering charges.

5. BRA--blow major bridge.[19]

a. Required information: number of Type A bridges.

b. Resource requirements per major bridge for superstructure only or superstructure and substructures.

(1) Destroy superstructure

(a) Squad hr: 3.0.

(b) Blade hr: none.

(c) Total logistical weight: 0.30 MT.

(2) Destroy superstructure and substructure

(a) Squad hr: 5.0.

(b) Blade hr: none.

(c) Total logistical weight: 0.82 MT.

c. Description: major four-lane highway bridge.

d. Additional information: 16 each 36 WF 160 at two ends.

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[19] *EFOSS*, pp N-III-e-1 through N-III-e-5; *Quantification of Mobility-Countermobility-Survivability Operations*; FM 5-25, Explosives and Demolitions (HQDA, Feburary 1971), pp 4-30 through 4-50.

6. BRB--blow primary bridge, Type B.[20]

   a. Required information: number of Type B bridges.

   b. Resource requirements per primary bridge for superstructure only or superstructure and substructures.

      (1) Destroy superstructure

         (a) Squad hr: 2.0.

         (b) Blade hr: none.

         (c) Total logistical weight: 0.19 MT.

      (2) Destroy superstructure and substructure

         (a) Squad hr: 3.5.

         (b) Blade hr: none.

         (c) Total logistical weight: 0.42 MT.

   c. Description: primary two-lane highway bridge.

   d. Additional information: eight each concrete T-beam AFT depth.

7. BRC--blow bridge, Type C, secondary two lane highway.[21]

   a. Required information: number of Type C bridges.

   b. Resource requirements per secondary bridge for superstructure only or superstructure and substructures.

      (1) Destroy superstructure

         (a) Squad hr: 1.0.

         (b) Blade hr: none.

         (c) Total logistical weight: 0.13 MT.

      (2) Destroy superstructure and substructure

         (a) Squad hr: 2.5.

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[20] *EFOSS*, pp N-III-e-1 through N-III-e-5; *Quantification of Mobility-Countermobility-Survivability Operations*; FM 5-25, Explosives and Demolitions (HQDA, February 1971), pp 4-30 through 4-50.

[21] *EFOSS*, pp N-III-e-1 through N-III-e-5; *Quantification of Mobility-Countermobility-Survivability Operations*; FM 5-25, Explosives and Demolitions (HQDA, February 1971), pp 4-30 through 4-50.

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(b) Blade hr: none.

(c) Total logistical weight: 0.37 MT.

c. Description: secondary two-lane highway bridge.

d. Additional information: five each steel stringers, 25.4 cm least dimension at two ends.

8. ABT--construct an abatis.[22]

a. Required information: number of abatis (100 m deep).

b. Resource requirements per abatis (100-m):

(1) Squad hr: 2.0.

(2) Blade hr: none.

(3) Total logistical weight: 0.08 MT.

c. Description: trees (40 cm diameter) are spaced 10 m apart on each side of the roadway (20 trees per 100 m abatis).

d. Additional information: blow one side at a time so trees do not fall into each other. Tape or wire will be needed to secure TNT to trees.

9. ATD--construct an antitank ditch.[23]

a. Required information: total meters of ATD and type of soil, sand or clay.

b. Resource requirements per 100 m of antitank ditch using one of two classes of equipment:

(1) A team of D7 dozer, ACE, or CEV and a 2.5 cu yd scoop loader

(a) Squad hr: none.

(b) Blade hr: sand = 3.0; clay = 4.0.

(c) Total logistical weight: none.

(2) A team of a T5 dozer and a 2.5 cu yd scoop loader

(a) Squad hr: none.

(b) Blade hr: sand = 4.5; clay = 6.0.

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[22] FM 5-102, pp 126, 194; *EFOSS*, pp N-III-j-1 through N-III-j-7; *Quantification of Mobility-Countermobility-Survivability Operations.*

[23] FM 5-102, p 116-125; *EFOSS*, pp N-III-h-1 through N-III-i-8; *Quantification of Mobility-Countermobility-Survivability Operations.*

(c) Total logistical weight: none.

c. Description: either a rectangular or triangular ditch 1.5 m deep by 3.3 m wide.

d. Additional information: use equipment in teams in "T-push" configuration. In sand rectangular ditches should be increased in depth to 1.6 m and triangular ditches should be increased to 1.8m.

10. WBT--general-purpose barbed-tape obstacle (GPBTO).[24]

a. Required information: total meters of WBT.

b. Resource requirements per 300 m GPBTO:

(1) Squad hr: 0.1.

(2) Blade hr: none.

(3) Total logistical weight: 0.94 MT.

c. Description: three coils of barbed tape placed side by side on the ground.

d. Additional information: estimate based on vehicular emplacement.

11. WTC--triple standard concertina.[25]

a. Required information: total meters of WTC.

b. Resource requirements per 300 m WTC:

(1) Squad hr: 3.0.

(2) Blade hr: none.

(3) Total logistical weight: 2.19 MT.

c. Description: two coils of concertina are placed side by side with a third coil placed on top.

d. Additional information: picket spacing for long pickets are five paces apart: short pickets are two paces from the end of long pickets and are used to anchor the horizontal wire. There are two rows of long pickets 0.9 m apart.

12. WRC--nonstandard concertina road block.[26]

a. Required information: number of concertina road blocks.

b. Resource requirements per road block:

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[24] *Quantification of Mobility-Countermobility-Survivability Operations.*
[25] FM 5-102, p 193; *Quantification of Mobility-Countermobility-Survivability Operations.*
[26] FM 5-102, p 194; *Quantification of Mobility-Countermobility-Survivability Operations.*

(1) Squad hr: 1.0.

(2) Blade hr: none.

(3) Total logistical weight: 0.43 MT.

c. Description: one roadblock is 11 coils placed side by side with three long pickets per coil which are five meters apart. Horizontal wire is placed on top of each coil and short pickets are used to anchor the horizontal wire.

d. Additional information: as roadblocks, several coils of barbed tape concertinas laid side by side will impede movement of vehicles. A series of these roadblocks should be placed about 10 m apart.

13. MFAT--RAAMS artillery delivered AT minefield.[27]

a. Required information: mine density per m^2 (0.001, 0.002, 0.004); low-angle fire (area covered 200 m by 200 m) or high-angle fire (area covered 400 m by 400 m); and number of minefields at that density and angle of fire.

b. Resource requirements per minefield:

(1) Squad hr: none.

(2) Blade hr: none.

(3) Logistics

	Density (mines/m^2)	Artillery Rounds
High-angle	0.001	24
	0.002	48
	0.004	96
Low-angle	0.001	6
	0.002	12
	0.004	24

c. Description: Remote Antiarmor Mine System (RAAMS), artillery delivered antitank minefield. Low-angle fire, area covered 200 m by 200 m; high-angle fire, area covered 400 m by 400 m.

d. Additional information: each round contains nine AT mines. No engineer resources are used.

14. MFAP--ADAM artillery delivered AP minefield.[28]

a. Required information: density (0.0005, 0.001, 0.002 mines/m^2); number of minefields (area covered 400 m by 400 m) at that density.

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[27] FM 5-102, p 185; *Quantification of Mobility-Countermobility-Survivability Operations.*

[28] FM 5-102, p 185.

b. Resource requirements per minefield:

(1) Squad hr: none.

(2) Blade hr: none.

(3) Logistics

Density (mines/m^2)	Rounds (each)
0.0005	3
0.001	6
0.002	12

c. Description: area denial artillery munition (ADAM), artillery delivered AP minefield. High-angle fire only, area covered 400 m by 400 m.

d. Additional information: each round contains 36 AP mines.

15. MFGT--minefield, GEMSS (AT only).[29]

a. Required information: total meters of front (assume one 60-m wide belt, multiply minefield width by number of belts to allow for more than one belt); density (0.001, 0.005, 0.007, 0.01, 0.025 mines/m^2).

b. Resource requirements per minefield: the effort and minefield length if an 800-mineload is fully dispensed as a function of the minefield density (60-m belt assumed, double the length if 30-m belts are used) is given below:

Density (mines/m^2)	0.001	0.005	0.007	0.01	0.025
Length (m)	13333	2666	1904	1333	533
Effort (squad hr)	2.24	0.45	0.32	0.22	0.09

Given the density and total meters of front, the number of 800-mine loads

$$= \frac{\text{Length of mine front}}{\text{Belt length for given density}}$$

(1) Squad hr = number of 800-mine loads x Effort for the given density (do not round)

+ Number of 800-mine loads x 0.04 hr (round to next higher integer)

(2) GEMSS hr: equal to squad hr.

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[29] FM 5-102, p 186; *EFOSS*, pp N-III-c-1 through N-III-d-9: *Quantification of Mobility-Countermobility-Survivability Operations*.

(3) Logistics:

Number of mines = Number of 800-mine loads x 800.
Total weight = Number of mines x 1.72 kg.

c. Description: Tactical AT minefield with variable densities emplaced with a Ground Emplaced Mine Scattering System (GEMSS) using M75 AT mines. Single belt can be 30-m or 60-m wide.

d. Additional information: two 60-m belts separated by 40 m are recommended. Three 60-m belts are optimum.

16. MFGP--minefield, GEMSS (AP only).[30]

a. Required information: total meters of front (assume one 60-m wide belt, multiply minefield width by number of belts to allow for more than one belt); density (0.001, 0.005, 0.007, 0.01, 0.025 mines/m^2).

b. Resource requirements per minefield: the effort and minefield length for an 800-mineload fully dispensed as a function of the minefield density (60-m belt assumed, double the length if 30-m belts are used) is given below:

Density (mines/m^2)	0.001	0.005	0.007	0.01	0.025
Length (m)	13333	2666	1904	1333	533
Effort (squad hr)	2.24	0.45	0.32	0.22	0.09

Given the density and total meters of front, the number of 800-mine loads

$$= \frac{\text{Length of mine front}}{\text{Belt length for given density}}$$

(1) Squad hr = number of 800-mine loads x Effort for the given density (do not round)

+ Number of 800-mine loads x 0.04 hr (round to next higher integer)

(2) GEMSS hr: equal to squad hr.

(3) Logistics:

Number of mines = Number of 800-mine loads x 800.
Total weight = Number of mines x 1.45 kg.

c. Description: Tactical AP minefield with variable densities emplaced with a Ground Emplaced Mine Scattering System (GEMSS) using M74 AP mines. Single belt can be 30-m or 60-m wide.

d. Additional information: two 60-m belts separated by 40 m are recommended. Three 60-m belts are optimum.

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[30] FM 5-102, p 186; *EFOSS*, pp N-III-C-1 through N-III-d-9; *Quantification of Mobility-Countermobility-Survivability Operations.*

17. MFGM--minefield, GEMSS (AT and AP mixed).[31]

a. Required information: total meters of front (assume one 60-m wide belt, multiply minefield width by number of belts to allow for more than one belt); density (0.001, 0.005, 0.007, 0.01, 0.025 mines/m^2); ratio of AT mines to AP mines (AT:AP).

b. Resource requirements per minefield: the effort and minefield length for an 800-mineload fully dispensed as a function of the minefield density (60-m belt assumed, double the length if 30-m belts are used) is given below:

Density (mines/m^2)	0.001	0.005	0.007	0.01	0.025
Length (m)	13333	2666	1904	1333	533
Effort (squad hr)	2.24	0.45	0.32	0.22	0.09

Given the density and total meters of front, the number of 800-mine loads

$$= \frac{\text{Length of mine front}}{\text{Belt length for given density}}$$

(1) Squad hr = number of 800-mine loads x Effort for the given density (do not round)

+ Number of 800-mine loads x 0.04 hr (round to next higher integer)

(2) GEMSS hr: equal to squad hr.

(3) Logistics:

Number of mines = Number of 800-mine loads x 800.

Number of AT mines = total mines x AT/(AT + AP).

Number of AP mines = total mines - AT mines.

Total weight = AT minex x 1.72 kg + AP mines x 1.45 kg.

c. Description: Tactical minefield with variable densities emplaced with a Ground Emplaced Mine Scattering System (GEMSS) using a mix of M75 AT and M74 AP mines. Single belt can be 30-m or 60-m wide.

d. Additional information: two 60-m belts separated by 40 m are recommended. Three 60-m belts are optimum. Recommended ratio of AT mines to AP mines is 5:1.

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[31] FM 5-102, p 186; *EFOSS*, pp N-III-c-1 through N-III-d-9; *Quantification of Mobility-Countermobility-Survivability Operations.*

18. MFMT--minefield, MOPMS, AT.[32]

a. Required information: total MOPMS AP packs.

b. Resource requirements per pack: none.

(1) Squad hr: 0.3.

(2) Blade hr: none.

(3) Total logistical weight: 0.07 MT.

c. Description: modular pack mine system (MOPMS). Each pack disperses 21 mines in a semicircle with a 35-m radius at a density of 0.01 mines/m^2.

d. Additional information: greater densities can be obtained by overlapping the dispensing pattern. MOPMS contain only AP or AT mines. A mixed minefield can be obtained by overlapping patterns of each type. If a mixed minefield is used, fire AP last; this will prevent the AT mines from landing on the AP mine tripwires and detonating the AP mines prematurely.

19. MFMP--minefield, MOPMS, AP.[33]

a. Required information: total MOPMS AP packs.

b. Resource requirements per pack: none.

(1) Squad hr: 0.3.

(2) Blade hr: none.

(3) Total logistical weight: 0.07 MT.

c. Description: modular pack mine system (MOPMS). Each pack disperses 21 mines in a semicircle with a 35-m radius at a density of 0.01 mines/m^2.

d. Additional information: greater densities can be obtained by overlapping the dispensing pattern. MOPMS contain only AP or AT mines. A mixed minefield can be obtained by overlapping patterns of each type. If a mixed minefield is used, fire AP last; this will prevent AT mines from landing on AP mine tripwires and detonating the AT mines prematurely.

20. MFH--M56 helicopter delivered AT mines.[34]

a. Required information: total M56 sorties.

b. Resource requirements:

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[32] FM 5-102, p 187; *EFOSS*, pp N-III-a-1 through N-III-a-5; *Quantification of Mobility-Countermobility-Survivability Operations.*

[33] FM 5-102, p 187; *EFOSS*, pp N-III-a-1 through N-III-a-5; *Quantification of Mobility-Countermobility-Survivability Operations.*

[34] FM 5-102, p 188; *Quantification of Mobility-Countermobility-Survivability Operations.*

(1) Squad hr: none.

(2) Blade hr: none.

(3) Logistics: M56 helicopter sorties

c. Description: one sortie delivers 20 m by 1600 m at 0.005 mines/m^2 or 20 m by 800 m at 0.01 mines/m^2.

d. Additional information: no engineer resources are used.

21. MFAF--GATOR, USAF delivered scatterable mines.[35]

a. Required information: number of canisters.

b. Resource requirements:

(1) Squad hr: none.

(2) Blade hr: none.

(3) Logistics: GATOR canisters.

c. Description: USAF delivered scatterable mines.

d. Additional information: each canister contains 72 AT and 22 AP mines. Density depends on the number of canisters dropped. Area of minefield depends on the aircraft's speed and altitude. Engineer resources are not used.

22. MFD--M57 antitank mine dispensing system.[36]

a. Required information: total meters of front (0.5 AT mines/m front).

b. Resource requirements per 500 m:

(1) Squad hr: 6.3

(2) M57 hr: 2.1.

(3) Total weight: 3.88 MT.

c. Description: minefield is 50 m deep.

d. Additional information: laying speed is 1 to 3 mph, depending on terrain. Limitation is the speed of the two persons standing in the truck loading the mines. Surface laying does not reduce time. It is recommended that an antipersonnel minefield with a density of 0.5 mines/m front be emplaced in the same area as the M57 minefield. A 5-ton dump truck will hold 288 racked mines.

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[35] FM 5-102, p 188.

[36] FM 5-102, p 189; *EFOSS*, pp N-III-C-1 through N-III-C-13; *Quantification of Mobility-Countermobility-Survivability Operations.*

23. MFJ--standard minefield (density* = 0.5-0.5-0).[37]

a. Required information: minefield front length (m).

b. Resource requirements per minefield: total number of mines, where L = front length in meters--

$$1.1 \times \frac{(0.5\,L + 0.5\,L)}{9} = \text{AT total}$$

(Note: M21 AT mines are used.)

$$1.1 \times \frac{(0.5\,L + 0.5\,L)}{9} = \text{APF total}$$

(Note: M16 APF mines are used).

$$\underline{\text{Manhours}} = \quad \frac{\text{AT total}}{4} \quad = \quad \text{AT manhours}$$

$$\frac{\text{APF total}}{8} \quad = \quad \text{APF manhours.}$$

(1) Squad hr: $\frac{\text{AT MH + APF MH.}}{8}$

(2) Blade hr: none.

(3) Total logistical weight:

AT weight = AT total x 8.16 kg
APF weight = APF total x 3.74 kg.

c. Description: hand-emplaced minefield.

d. Additional information: assume mines are onsite. Irregular outer layer (IOE) representative cluster composition is the same as the density. Round all numbers to the next highest integer. Meters are used as the unit of measurement during installation.

24. MFK--standard minefield (density = 1-1-1).[38]

a. Required information: minefield front length (m).

b. Resource requirements per minefield: total number of mines, where L = front length in meters--

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*Mines/m front, antitank: antipersonnel fragment: antipersonnel blast.

[37] FM 20-32, *Mine/Countermine Operations at the Company Level* (HQDA, November 1976).

[38] FM 20-32.

$$1.1 \times \frac{(L + L)}{9} = \text{AT total}$$

(Note: M21 AT mines are used.)

$$1.1 \times \frac{(L + L)}{9} = \text{APF total}$$

(Note: M16 APF mines are used.)

$$1.1 \times \frac{(L + L)}{9} = \text{APB total}$$

(Note: M14 APB mines are used.)

Manhours--

$$\frac{\text{AT total}}{4} = \text{AT manhours}$$

$$\frac{\text{APF total}}{8} = \text{APF manhours}$$

$$\frac{\text{APB total}}{16} = \text{APB manhours.}$$

(1) Squad hr: $\frac{\text{AT MH + APF MH + APB MH.}}{8}$

(2) Blade hr: none.

(3) Total weight:

AT weight = AT total x 8.16 kg
APF weight = APF total x 3.74 kg
APB weight = APB total x 0.1 kg.

c. Description: hand-emplaced minefield.

d. Additional information: assume mines are onsite. IOE representative cluster composition is the same as the density. Round all numbers to next highest integer. Meters are used as the unit of measurement during installation.

APPENDIX E:

RESOURCE REQUIREMENTS FOR SURVIVABILITY TASKS--INITIAL ESTIMATE

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1. Deliberate fighting position, M1/M60 tank[39]

   a. Required information: number of deliberate fighting positions for tanks and type of equipment used.

   b. Resource requirements per deliberate position using one of two classes of equipment:

      (1) D7 Dozer, ACE, or CEV
      Blade hr: 1.50

      (2) T5 Dozer
      Blade hr: 2.25

   c. Description: excavate a primary, secondary, or alternate deliberate turret defilade position for an M1, M60, or M48 tank.

   d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

2. Deliberate fighting position, M2/M3 fighting vehicle.[40]

   a. Required information: number of deliberate fighting positions for M2s and M3s and type of equipment used.

   b. Resource requirements per deliberate position using one of two classes of equipment:

      (1) D7 Dozer, ACE, or CEV
      Blade hr: 1.20

      (2) T5 Dozer
      Blade hr: 1.80

   c. Description: excavate a primary, secondary, or alternate deliberate turret defilade position for an M2 or M3 fighting vehicle.

   d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

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[39] Field Manual (FM) 5-103, Survivability (HQ, U.S. Department of the Army [USDA], June 1985, p 4-13, 4-15; *EFOSS*, pp N-III-q-1 through N-III-s-2; *U.S. Army Engineer Assessment, Europe* (U), Vol. II (U.S. Army Corps of Engineers, Engineer Studies Center, June 1981), Figure B-1-11.

[40] FM 5-103, p 4-13; *EFOSS: U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.

3. Deliberate fighting position, M113 series carriers.[41]

a. Required information: number of deliberate fighting positions for M113 chassis vehicles and type of equipment used.

b. Resource requirements per deliberate position using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV
Blade hr: 0.70

(2) T5 Dozer
Blade hr: 1.05

c. Description: excavate a primary, secondary, or alternate deliberate turret defilade position for an M113 chassis vehicle to include Improved TOW Vehicles, Mortar carriers, and Vulcans.

d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

4. Protective position, Howitzer, SP and ammo carrier.[42]

a. Required information: number of protective positions for self-propelled howitzers and type of equipment used.

b. Resource requirements per protective position using one of two classes of equipment:

(1) D7 Dozer, ACE or CEV
Blade hr: 2.5

(2) T5 Dozer
Blade hr: 3.75

c. Description: excavate a protective position for a self-propelled howitzer and ammo carrier. Position provides approximately 1 m clearance around the vehicle for maintenance.

d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

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[41] FM 5-103, p 4-13, 4-15; *EFOSS; U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.

[42] FM 5-103, p 4-16, 4-18; *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.

5. Protective position, Howitzer, towed.[43]

a. Required information: number of protective positions for towed howitzers and type of equipment used.

b. Resource requirements per protective position using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV
Blade hr: 0.30

(2) T5 Dozer
Blade hr: 0.45

c. Description: excavate a protective position for a towed howitzer.

d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

6. Deliberate position, M577 CP carrier.[44]

a. Required information: number of deliberate positions for command post carriers and type of equipment used.

b. Resource requirements per deliberate position using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV
Blade hr: 0.80

(2) T5 Dozer
Blade hr: 1.20

c. Description: excavate a primary or alternate deliberate hull defilade position for a command post carrier.

d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

7. Protective position, noncombat support vehicles.[45]

a. Required information: number of protective positions for support vehicles and type of equipment used.

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[43] FM 5-103, p 4-16, 4-18; *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.
[44] FM 5-103, p 4-15; *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.
[45] FM 5-103, p 4-19; *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.

b. Resource requirements per protective position using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV
Blade hr: 1.50

(2) T5 Dozer
Blade hr: 2.25

c. Description: excavate a deep-cut vehicle position to provide protection for support vehicles to include tracked recovery vehicles, cargo trucks, maintenance and computer vans, and POL transporters.

d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. Above times are an average for various support vehicles.

8. Berm for CHAPARRAL.[illegible]

a. Required information: total berms for CHAPARRAL.

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 dozer, ACE, or CEV
Blade hr: 0.90.

(2) T5 dozer
Blade hr: 1.35.

c. Description: construct a berm for CHAPARRAL.

d. Additional information: none.

9. Berm for forward area alert radar (FAAR).[illegible]

a. Required information: total berms for FAAR and location.

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 dozer, ACE, or CEV and 2.5 cu yd scoop loader
Blade hr: 1.80.

(2) T5 dozer and 2.5 cu yd scoop loader
Blade hr: 2.70.

c. Description: construct a berm for FAAR.

d. Additional information: none.

[illegible] *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.
[illegible] *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.

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10. Berm for CB/CM radar (FA).[48]

a. Required information: total berms for CB/CM radar (FA).

b. Resource requirements per berm using one of two classes or equipment:

(1) D7 dozer, ACE, or CEV
Blade hr: 0.45.

(2) T5 dozer
Blade hr: 0.68.

c. Description: construct a berm for CB/CM radar (FA).

d. Additional information: none.

11. Berm for HAWK launcher.[49]

a. Required information: total berms for HAWK launcher.

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 dozer, ACE, or CEV
Blade hr: 2.10.

(2) T5 dozer
Blade hr: 3.20.

c. Description: construct a berm for a HAWK launcher.

d. Additional information: none.

12. Berm for information coordination center (HAWK).[50]

a. Required information: total berms for information coordination center (HAWK).

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 dozer, ACE, or CEV or 2.5 cu yd scoop loader
Blade hr: 1.20.

(2) T5 dozer and 2.5 cu yd scoop loader
Blade hr: 1.80.

c. Description: construct a berm for a HAWK information coordination center.

d. Additional information: none.

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[48] *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.
[49] *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.
[50] *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.

c/9

13. Berm for PAR/ROR/CWAR/HIPIR (HAWK).[51]

a. Required information: total berms for PAR/ROR/CWAR/HIPIR (HAWK).

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 dozer, ACE, or CEV
Blade hr: 1.58.

(2) T5 dozer
Blade hr: 2.37.

c. Description: construct berm for PAR/ROR/CWAR/HIPIR (HAWK).

d. Additional information: none.

14. Berm for generator (HAWK).[52]

a. Required information: total berms for generator (HAWK).

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 dozer, ACE, or CEV
Blade hr: 1.13.

(2) T5 dozer
Blade hr: 1.70.

c. Description: construct a berm for a HAWK generator.

d. Additional information: none.

15. Cut slot for battery control center (HAWK).[53]

a. Required information: total slots for battery control (HAWK).

b. Resource requirements per cut slot using one of two classes of equipment:

(1) D7 dozer, ACE, or CEV or 2.5 cu yd scoop loader
Blade hr: 3.6

(2) T5 dozer and 2.5 cu yd scoop loader
Blade hr: 5.40.

c. Description: excavate slot for HAWK battery control center.

d. Additional information: none.

U.S. Army Engineer Assessment, Europe (U), Figure B-1-11.
U.S. Army Engineer Assessment, Europe (U), Figure B-1-11.
U.S. Army Engineer Assessment, Europe (U), Figure B-1-11.

16. Cut slot for platoon command post (HAWK).

   a. Required information: total slots for platoon command post (HAWK).

   b. Resource requirements per cut slot using one of two classes of equipment:

      (1) D7 dozer, ACE, or CEV and 2.5 cu yd scoop loader
      Blade hr: 1.20.

      (2) T5 dozer and 2.5 cu yd scoop loader
      Blade hr: 1.80.

   c. Description: excavate slot for HAWK command post platoon.

   d. Additional information: none.

17. Construct vehicle trench (communications).

   a. Required information: total vehicle trenches (50-m length).

   b. Resource requirements per vehicle trench using one of two classes of equipment:

      (1) D7 dozer, ACE, or CEV and 2.5 cu yd scoop loader
      Blade hr: 2.52.

      (2) T5 dozer and 2.5 cu yd scoop loader
      Blade hr: 3.78.

   c. Description: excavate a trench to provide a vehicle route protected on both sides from enemy small-arms and artillery shell fragments. Estimate is based on 50 m of trench.

   d. Additional information: a rectangular-shaped trench with a trapezoidal-shaped parapet on each side is assumed. The parapet is assumed to be 1 m wide at the top and 1 m high. Trench dimensions are depth, 1.8 m, and width, 3.5 m.

18. Construct shelter for command and communications facilities.

   a. Required information: number of shelters.

   b. Resource requirements per shelter for one of two types of construction:

      (1) Log frame, use scoop loader.

         (a) Squad hr: 14.7.

         (b) Blade hr: 7.00.

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[54] *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.

[55] *EFOSS*, pp N-III-y-1 through N-III-y-4; *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.

[56] *EFOSS*, pp N-III-z-1 through N-III-z-13; *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.

(c) Total logistical weight: none.

(2) Aluminum frame, use scoop loader.

(a) Squad hr: 15.1.

(b) Blade hr: 6.50.

(c) Logistics: 1 shelter.

Total weight: 0.48 MT.

c. Description: construct a cut-and-cover shelter suitable for a command post or tactical operations center bunker and covered with waterproofing material and 0.46 m of earth.

d. Additional information:

(1) Log frame--interior dimensions are 2.4 by 3.4 m. Interior height is 2.1 m.

(2) Aluminum frame--interior dimensions are 2.7 by 3.7 m and inside height is 2.0 m.

19-76. Dig in a maneuver unit for a given TOE listed below.[57]

a. Required information: maneuver unit's TOE task number; percentage of fighting vehicles to be dug in; percentage of support vehicles to be dug in; class of equipment used to dig unit in.

b. Resource requirements per position using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV

Blade hr: Sum of the blade hours calculated in paragraphs a through g below.

(a) Tanks. Multiply the total number of tanks by the percentage of fighting vehicles to be dug in and by 1.50 blade hr/vehicle.

(b) M2/M3 fighting vehicles. Multiply the number of M2/M3 fighting vehicles by the percentage of fighting vehicles to be dug in and by 1.20 blade hr/vehicle.

(c) M113 series carriers. Sum the number of M113 chassis vehicles to include Improved TOW Vehicles, Mortar carriers, and Vulcans. Multiply this figure by the percentage of fighting vehicles to be dug in and by 0.70 blade hr/vehicle.

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[57] FM 5-103, p 4-15 thru 4-19; *U.S. Army Engineer Assessment, Europe* (U), Figure B-1-11.

(d) Howitzers, SP 8-in./155-mm. Sum the number of self propelled howitzers. Multiply this figure by the percentage of fighting vehicles to be dug in and by 2.50 blade hr/position. Note: these positions include room for protecting for the ammo carriers.

(e) Howitzers, 155-mm or 105-mm towed. Sum the number of 155-mm and 105-mm towed howitzers. Multiply this figures by the percentage of fighting vehicles to be dug in and by 0.30 blade hr/position to find the blade hours required to dig in all towed howitzer protective positions.

(f) M577 CP carriers. Multiply the number of command post carriers by the percentage of support vehicles to be dug in and by 0.80 blade hr/vehicle.

(g) Noncombat tracked and wheeled vehicles. Sum the number of noncombat vehicles. Multiply this figure by the percentage of support vehicles to be dug in and by 1.50 blade hr/vehicle.

(2) Airborne/Airmobile earthmoving equipment (T5 Dozer)

Blade hr: Sum of the blade hours calculated in paragraphs a through g below.

(a) Tanks. Multiply the total number of tanks by the percentage of fighting vehicles to be dug in and by 2.25 blade hr/vehicle.

(b) M2/M3 fighting vehicles. Multiply the number of M2/M3 fighting vehicles by the percentage of fighting vehicles to be dug in and by 1.80 blade hr/vehicle.

(c) M113 series carriers. Sum the number of M113 chassis vehicles to include Improved TOW Vehicles, Mortar carriers, and Vulcans. Multiply this figure by the percentage of fighting vehicles to be dug in and by 1.05 blade hr/vehicle.

(d) Howitzers, SP 8-in./155-mm. Sum the number of self-propelled howitzers. Multiply this figure by the percentage of fighting vehicles to be dug in and by 3.75 blade hr/position. Note: these positions include room for protecting for the ammo carriers.

(e) Howitzers, 155-mm or 105-mm towed. Sum the number of 155-mm and 105-mm towed howitzers. Multiply this figures by the percentage of fighting vehicles to be dug in and by 0.45 blade hr/position to find the blade hours required to dig in all towed howitzer protective positions.

(f) M577 CP carriers. Multiply the number of command post carriers by the percentage of support vehicles to be dug in and by 1.20 blade hr/vehicle.

(g) Noncombat tracked and wheeled vehicles. Sum the number of noncombat vehicles. Multiply this figure by the percentage of support vehicles to be dug in and by 2.25 blade hr/vehicle.

c. Description: these tasks calculate the effort required to dig in a specified percentage of vehicles for a given maneuver unit. Resources are for digging only one position per vehicle. The task can be repeated to calculate the effort for secondary and alternate positions for combat vehicles.

d. Additional information: the type and number of vehicles assigned to a maneuver unit with a given TOE can be found in Appendix B. The task number for a given TOE is listed below:

19. ANTIARMOR CO, INF BN (M) ITV, 01OCT82, 07248J400
20. ARMD CAV REGT, 01APR84, 17051J330
21. ARMD CAV REGT, E/W M1/M3, 01APR84, 17051J320
22. ARMD CAV REGT, W/M60/M113/ITV, 01APR84, 17051J320
23. ARMD CAV SQDN, ARMD CAV REGT, 01APR84, 17055J330
24. ARMD CAV SQDN, ARMD CAV REGT, 01APR84, 17055J310
25. ARMD CAV SQDN, ACR, M1/M3, 01APR84, 17055J320
26. ARMD CAV TRP, ARMD CAV REGT, 30NOV70, 17058H000
27. ARMD CAV TRP, ARMD CAV REGT, 30NOV70, 17058H020
28. ARMD CAV TRP, AC SQDN, M113/M60, 01APR84, 17057J310
29. ARMD CAV TRP, AC SQDN, M1/M3, 01APR84, 17057J320
30. CSC, INF BN (MECH), W/106, 30NOV70, 07048H010
31. CSC, INF BN MECH-18 TOW, 30NOV70, 07048H030
32. CSC, INF BN MECH-12 TOW, 30NOV70, 07048H020
33. FA BN, 105-mm T, INF DIV, 20APR79, 06155H000
34. FA BN, 155 SP HVY DIV, 01OCT82, 06365J410
35. FA BN, 155 SP HVY DIV, 01OCT82, 06365J420
36. FA BN, 155 SP HVY DIV, 01OCT82, 06365J430
37. FA BN, 155-mm/8-in., INF DIV, 20APR79, 06165H000
38. FA BN, 8 in./MLRS HVY DIV, 01OCT82, 06395J200
39. FA BTRY, 155 SP HVY DIV, 01OCT82, 06367J410
40. FA BTRY, 155-mm T, FA BN, 09AUG78, 06167H000
41. FA BTRY, 8-in. SP HVY DIV, 01OCT82, 06397J200
42. FA BTRY, FA BN, 8-in. SP, 09AUG78, 06358H000
43. HHB 8-in./MLRS BN HVY DIV, 01OCT82, 06396J200
44. HHB, 155 T/8-in. SP, FA BN, 20APR79, 06166H000
45. HHB, FA BN, 105-mm TOWED, 20APR79, 06156H000
46. HHB, FA BN, 105-mm TOWED, 09AUG78, 06157H000
47. HHB, FA BN, 155 SP HVY DIV, 01OCT82, 06366J410
48. HHB, FA BN, 155 SP HVY DIV, 01OCT82, 06366J420
49. HHB, FA BN, 155 SP HVY DIV, 01OCT82, 06366J430
50. HHC, INF BN (MECH), 30NOV70, 07046H010
51. HHC, INF BN (MECH), 30NOV70, 07046H020
52. HHC, INF BN MECH BFVS, 01APR83, 07246J410
53. HHC, INF BN MECH M113, 01APR83, 07246J420
54. HHC, TK BN, M65, 01OCT81, 17236J1110
55. HHT, ARMD CAV REGT, 01APR84, 17052J310
56. HHT, ARMD CAV REGT, 01APR84, 17052J320
57. HHT, ARMD CAV SQDN, 01APR84, 17056J310
58. HHT, ARMD CAV SQDN, 01APR84, 17056J320
59. HHT, ARMD CAV SQDN, 01APR84, 17056J330
60. INF BN (MECH) E/W 106, 30NOV70, 07045H010
61. INF BN E/W 12 TOW, 30NOV70, 07045H020
62. INF BN E/W 18 TOW, 30NOV70, 07045H030

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63. INF BN-MECH E/W BFVS, 01APR83, 07245J410
64. INF BN-MECH E/W M113, 01APR83, 07245J420
65. RIFLE CO, INF BN MECH M113, 01OCT82, 07247J420
66. RIFLE CO, INF BN, (MECH), 30NOV70, 07047H010
67. RIFLE CO, INF BN, (MECH), 30NOV70, 07047H020
68. RIFLE CO, INF BN, MECH BFVS, 01OCT82, 07247J410
69. SVC BTRY, 155 SP HVY DIV, 01OCT82, 06369J410
70. SVC BTRY, 155-mm T/8-in. SP, 30NOV70, 06169H000
71. SVC BTRY, 8 in./MLRS HVY DIV, 01OCT82, 06399J200
72. SVC BTRY, FA BN, 105-mm TOWED, 20APR79, 06159H000
73. TK BN, EQ W/M1, 01APR84, 17235J420
74. TK BN, EQ/W M60, 01APR84, 17235J410
75. TK CO, (M1), 01APR84, 17237J420
76. TK CO, TK BN M60, 01APR84, 17237J410

Note: Additional TOE's can be added from the utilities menu "Edit Unit's TOE" function.

APPENDIX F:

RESOURCE REQUIREMENTS FOR MOBILITY TASKS - DETAILED ESTIMATE

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1. Repair and maintain MSR (two-lane bituminous).[58]

   a. Required information: MSR distance (km); duration (days) MSR will be repaired and maintained; location.

   b. Resource requirements per kilometer for 5 days:

      (1) Squad hr: 0.6.

      (2) Equipment hr:

      - Four graders at 5 hr = 1.3
      - Eight 5-ton dump trucks at 5 hr = 2.5
      - Four bitum kettles (165-gal) at 5 hr = 1.3.

      (3) Logistics

      - Asphalt, 55-gal drums = 0.4 each
      - Culvert = 1.7 m
      - Aggregate = 3.8 cu yd.

      Total weight: 0.08 MT.

   c. Description: MSR is assumed to be a two-lane, bituminous surface road on which there is two-way traffic.

   d. Additional information: it is assumed that aggregate is procured locally and the asphalt is provided by assets located outside the unit maintaining the MSR. The scoop loader is organic to the asphalt production plant.

2. Repair and maintain an unpaved secondary road (two-lane, Class D).[59]

   a. Required information: distance of unpaved secondary road (km); duration (days) the road will be repaired and maintained; location.

   b. Resource requirements per kilometer for 5 days:

      (1) Squad hr: 0.6.

      (2) Equipment hr:

      - Four graders at 0.3 hr = 1.3
      - Four 5-ton dump trucks at 0.3 hr = 1.3
      - One 2.5 cu yd scoop loader at 0.3 hr = 0.3
      - Four water distributors at 0.3 hr = 1.3
      - One vibratory roller at 0.3 hr = 0.3.

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[58] *EFOSS*, p N-III-cc-1 through N-III-cc-4; TM 5-303, p 1319.

[59] *EFOSS*, p N-III-dd-1 through N-III-dd-5; TM 5-303, p 1319.

(3) Logistics

o Culvert = 0.75 m
o Aggregate = 7.5 cu yd.

Total weight: 0.01 MT.

c. Description: it is assumed that roads are average Class D, two-lane, graded and drained earth types over average rolling terrain and moderate rock.

d. Additional information: dump trucks are used as tow vehicles for water distributors. The compactor and scoop loader are required for major road failures. It is assumed that aggregate is procured locally.

3. Repair and maintain an unpaved one-lane combat road.[60]

a. Required information: combat road distance (km); duration (days) the combat road will be repaired and maintained; location.

b. Resource requirements per kilometer for 5 days:

(1) Squad hr = 0.6.

(2) Equipment hr:

o Four graders at 0.3 hr = 1.3
o Four 5-ton dump trucks at 0.3 hr = 1.3
o One 2.5 cu yd scoop loader at 0.3 hr = 0.3.

(3) Logistics

o Culvert = .75 m
o Aggregate = 0.4 cu yd.

Total weight: 0.01 MT.

c. Description: road is assumed to be an average Class D, single-lane, graded and drained earth type over rolling terrain with moderate rock.

d. Additional information: other assumptions are as follow. Maintenance of the combat road does not require water distributors. A scoop loader is to load aggregate for patching badly worn areas. Aggregate is procured locally.

4. Construct an unpaved secondary road, Class C (two-lane).[61]

a. Required information: Class C road distance (km); location.

b. Resource requirements per kilometer using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV with a 2.5 cu yd scoop loader

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[60] *EFOSS*, pp N-III-ee-1 through N-III ee-5; TM 5-303, p 1300.
[61] *EFOSS*, pp N-III-ff-1 through N-III-ff-7; TM 5-303, p 1300.

(a) Squad hr: 220.0.

(b) Equipment hr:

Twelve D7 dozers, ACEs, or CEVs at 75.0 hr	900.0
Thirteen M916 Tractors w/trailer at 75.0 hr (If ACEs or CEVs are used one M916 at 75.0 hr)	975.0
Three 2.5 cu yd scoop loaders at 75.0 hr	225.0
Three graders at 75.0 hr	225.0
One 13- wheel (towed) roller at 75.0 hr	75.0
One 10-ton steel wheel roller at 75.0 hr	75.0
One crane at 75.0 hr	75.0
Six 5-ton dump trucks at 75.0 hr	450.0
One light vehicle at 75.0 hr	75.0
One water distributor at 75.0 hr	75.0
Five air compressors at 75.0 hr	375.0

(c) Logistics:

Culvert	960 m
Aggregate	980 m

Total weight: 0.50 MT

(2) T5 Dozer with a 2.5 cu yd scoop loader

(a) Squad hr: 220.0

(b) Equipment hr:

Twelve T5 Dozers at 112.5 hr	1350.0
Seven M916 Tractors w/trailer at 112.5 hr	787.5
Three 2.5 cu yd scoop loaders at 112.5 hr	337.5
Three graders at 112.5 hr	337.5
One 13- wheel (towed) roller at 112.5 hr	112.5
One 10-ton steel wheel roller at 112.5 hr	112.5
One crane at 112.5 hr	112.5
Six 5-ton dump trucks at 112.5 hr	675.0
One light vehicle at 112.5 hr	112.5
One water distributor at 112.5 hr	112.5
Five air compressors at 112.5 hr	562.5

(c) Logistics:

Culvert	960 m
Aggregate	980 m

Total weight: 0.50 MT

e. Description: road is average Class C over rolling terrain, average woodland vegetation, and moderate rock. Estimate includes construction of drainage ditches and culverts, but not bridges.

d. Additional information: one ACE or CEV can be substituted for one D7 dozer and one M916 tractor with trailer. It is assumed that aggregate is procured locally.

5. Construct a combat trail.[92]

a. Required information: combat trail distance (km); location.

b. Resource requirements per kilometer using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV

(a) Squad hr: 14.2.

(b) Equipment hr:

- One 5-ton dump truck	11.4
- One D7 dozer, ACE, or CEV	11.4
- One M916 Tractor w trailer	11.4

(c) Total logistical weight: none

(2) T5 Dozer

(a) Squad hr: 14.2.

(b) Equipment hr:

- One 5-ton dump truck	17.1
- One T5 dozer	17.1
- One M916 Tractor w trailer	8.6

(c) Total logistical weight: none

c. Description: combat trail is designed to allow passage of tracked vehicles and most wheeled vehicles. Width is therefore approximately 4 m. Only impossible obstacles will be removed. The natural cover will be disturbed as little as possible.

d. Additional information: assumptions are as follow: No hauling of fill or surface material is required; however, ravines and steep hills occasionally will require fill or cut capability. Trees have diameters of 15 to 20 cm and a 3-m spacing. This results in one tree per 3 m trail that must be cut and removed. Twenty cubic meters cut and 20 m^3 fill are required per 100 m trail. One ACE or one CEV may be substituted for one D7 dozer and one M916 tractor with trailer.

6. Reduce a dry gap bank grade for vehicle passage.[93]

a. Required information: number of dry gaps; location.

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[92] *EFOSS*, pp N-III-gg-1 through N-III-gg-5.
[93] *EFOSS*, pp N-III-hh-1 through N-III-hh-5.

F5 0

b. Resource requirements per dry gap using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV

(a) Squad hr: none.

(b) Equipment hr:

- One D7 dozer, ACE, or CEV	1.0
- One M916 Tractor w/trailer	1.0

(c) Total logistical weight: none

(2) T5 Dozer

(a) Squad hr: none.

(b) Equipment hr:

- One T5 dozer	1.5
- One M916 Tractor w/trailer	0.8

(c) Total logistical weight: none

c. Description: work consists of cutting single-lane approaches through steep banks to provide access into and egress from a dry streambed or streambed containing a shallow, fordable stream.

d. Additional information: assume the following. Dry weather and average soil conditions prevail. There are no large trees on banks. Ground is level above steep banks, and steep banks are 2 m above streambed. Earth excavated from uproad will be spread or piled in the streambed. The streambed is stable for traffic. One ACE or one CEV be substituted for one D7 dozer and one M916 tractor with trailer.

7. Construct a temporary ford site.**

a. Required information: number of ford sites; location.

b. Resource requirements per ford site using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV with a 2.5 cu yd scoop loader

(a) Squad hr: 0.8.

(b) Equipment hr:

- one D7 dozer, ACE or CEV	3.3
- one M916 tractor w/trailer	3.3
- one 2.5 cu yd scoop loader	3.3

**EFOSS, pp N-III-ii-1 through N-III-ii-7.

- three 5-ton dump trucks @3.3 hr	9.9
- one 5-ton vehicle	3.3

(c) Total logistical weight: none.

(2) T5 Dozer with a 2.5 cu yd scoop loader

(a) Squad hr: 0.8.

(b) Equipment hr:

- one T5 dozer	4.9
- one M916 tractor w/trailer	2.5
- one 2.5 cu yd scoop loader	4.9
- three 5-ton dump trucks @4.9 hr	14.6
- one 5-ton vehicle	4.9

(c) Total logistical weight: none

c. Description: work consists of cutting single-lane approaches through steep banks on both sides of the streambed, stabilizing the approaches and the streambed with coarse aggregate, and marking the approaches and ford for vehicle drivers.

d. Additional information: assume the following. Stream width is 10 m and exposed stream bottom is approximately 4 m wide on each side of stream, requiring stabilization. Stream is no more than 0.75 m deep. Stream velocity is less than 1 m/sec. Bank is 2 m high. Both approaches and stream bottom require stabilization. Aggregate is 20 cm deep for approaches and exposed stream bottom, and 30 cm deep for the ford. Aggregate is 3.5 m wide on the approaches, and 5 m wide in the ford.

8. Conduct a hasty assault minefield breach.[illegible]

a. Required information: total meters of minefield; method of breach; location.

b. Resource requirements per breach using one of the following two methods:

(1) M173 Charge per 70 m

(a) Squad hr: none.

(b) Equipment hr:

- One CEV	1.0
- One 5-ton truck	1.0

(c) Logistics:

- M 173 kit	1.0 each
Total Weight: 1.40 MT	

[illegible] *EFOSS*, pp N-III-jj-1 through N-III-jj-7; *Surface Air Explosive (SLUFAE)*.

[illegible] AVAILABLE

(2) Mine Clearing Line Charge (MICLIC) per 100 m

(a) Squad hr: none.

(b) Equipment hr:

- M353 3-1/2 ton trailer	0.5
- MK122 launcher assembly	0.5

(c) Logistics:

- M58A3 line charge	1.0	each
- MK22 Mod 4 rocket	1.0	each
Total weight 1.60	MT	

c. Description: breach a lane 5 m (4.6 m for M173) wide in an antitank minefield by methods requiring the least possible planning and preparation.

d. Additional information: Assume the minefield trace was located previously. Effort described is for a single-lane 100 m long for MICLIC and 70 m long for M173. Effort for breach of more than one lane can be calculated by taking multiples of the effort for a single lane. A second MICLIC may be fired from the breached lane if a longer breach is required. After firing, the empty trailer may be used to draw another rocket and line charge. Suitable combat vehicles will tow the MICLIC trailers to point of breach.

9. Breach antitank ditch.[66]

a. Required information: number of antitank ditches, method used, and length of time AVLB will be in place if used.

b. Resource requirements per breach using one of the following four methods:

(1) D7 Dozer, ACE, or CEV

(a) Squad hr: none.

(b) Equipment hr:

- One D7 Dozer, ACE, or CEV	0.1
- One M916 tractor with trailer	0.1

(c) Total logistical weight: none.

(2) T5 Dozer

(a) Squad hr: none.

(b) Equipment hr:

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[66] *Quantification of Mobility-Countermobility-Survivability Operations.*

- One T5 Dozer	0.2
- One M916 tractor with trailer	0.1

(c) Total logistical weight: none.

(3) 2.5 cu yd scoop loader

(a) Squad hr: none.

(b) Equipment hr:

- One Scoop Loader	0.1

(c) Total logistical weight: none.

(4) AVLB

(a) Squad hr: none.

(b) Equipment hr:

- One AVLB (bridge)	0.1	+ time in place

(c) Total logistical weight: none.

c. Description: breach antitank ditch to allow passage of vehicles.

d. Additional information: none.

10. Breach road crater.[67]

a. Required information: number of road craters, method used, and length of time AVLB will be in place if used.

b. Resource requirements per breach using one of the following four methods:

(1) D7 Dozer, ACE, or CEV

(a) Squad hr: none.

(b) Equipment hr:

- One D7 Dozer, ACE, or CEV	0.1
- One M916 tractor with trailer	0.1

(c) Total logistical weight: none.

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[67] *Quantification of Mobility/Countermobility/Survivability Operations.*

(2) T5 Dozer

(a) Squad hr: none.

(b) Equipment hr:

- One T5 Dozer	0.2
- One M916 tractor with trailer	0.1

(c) Total logistical weight: none.

(3) 2.5 cu yd scoop loader

(a) Squad hr: none.

(b) Equipment hr:

- One scoop loader	0.1

(c) Total logistical weight: none.

(4) AVLB

(a) Squad hr: none.

(b) Equipment hr:

- One AVLB (bridge)	0.1	+ time in place

(c) Total logistical weight: none.

c. Description: breach road crater to allow passage of vehicles.

d. Additional information: none.

11. Breach abatis.**

a. Required information: number of abatis (100 m) and method used.

b. Resource requirements per breach using one of the following six methods:

(1) D7 Dozer or ACE

(a) Squad hr: none.

(b) Equipment hr:

- One D7 Dozer or ACE	1.0
- One M916 tractor with trailer	1.0

(c) Total logistical weight: none.

***Quantification of Mobility-Countermobility-Survivability Operations.*

65

(2) CEV (with 5 rounds)

(a) Squad hr: none.

(b) Equipment hr:

One CEV	0.3

(c) Logistics:

CEV rounds	5	ea
Total weight:	0.21	MT

(3) T5 Dozer

(a) Squad hr: none.

(b) Equipment hr:

- One T5 Dozer	1.5
- One M916 tractor with trailer	0.8

(c) Total logistical weight: none.

(4) Handtools

(a) Squad hr: 24.0.

(b) Equipment hr: none.

(c) Total logistical weight: none.

(5) Chainsaws

(a) Squad hr: 2.0.

(b) Equipment hr:

- Eight chainsaws @ 2.0 hrs	16.0

(c) Total logistical weight: none.

(6) Explosives (TNT in 1 lb blocks)

(a) Squad hr: 1.0.

(b) Equipment hr: none.

(c) Logistics:

- TNT, 1 lb blocks	460	ea
Total weight:	0.21	MT

[illegible] AVAILABLE

c. Description: breach an abatis to allow vehicle passage.

d. Additional information: none.

12. Breach wire obstacle.[69]

a. Required information: number of wire obstacles and method used.

b. Resource requirements per obstacle breach using one of the following three methods.

(1) CEV (with 2 rounds)

(a) Squad hr: none.

(b) Equipment hr:

- One CEV 0.1

(c) Logistics:

- CEV rounds 2 ea

Total weight: 0.08 MT

(2) Handtools

(a) Squad hr: 0.1.

(b) Equipment hr: none.

(c) Total logistical weight: none.

(3) Bangalore Torpedoes

(a) Squad hr: 0.1..

(b) Equipment hr: none

(c) Logistics:

- M1A1 bangalore torpedoes 2 ea

Total weight: 0.12 MT

c. Description: breach a wire obstacle; breached area is 0.6 m by 20 m.

d. Additional information: none.

13. Breach roadblock.[70]

a. Required information: number of roadblocks and method used.

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[69] *Quantification of Mobility-Countermobility-Survivability Operations.*

[70] *Quantification of Mobility-Countermobility-Survivability Operations.*

b. Resource requirements per roadblock using one of the following four methods.

(1) D7 Dozer or ACE

(a) Squad hr: none.

(b) Equipment hr:

- one D7 Dozer or ACE	0.3
- one M916 tractor w/trailer	0.3

(c) Total logistical weight: none.

(2) CEV (with 2 rounds).

(a) Squad hr: none.

(b) Equipment hr:

- One CEV	0.1

(c) Logistics:

- CEV rounds	2	ea
Total weight:	0.08	MT

(3) T5 Dozer

(a) Squad hr: none.

(b) Equipment hr:

- one T5 Dozer	0.5
- one M916 tractor w/trailer	0.3

(c) Total logistical weight: none.

(4) Explosives and handtools

(a) Squad hr: 0.3.

(b) Equipment hr: none.

(c) Logistics:

- TNT, 1 lb blocks	88	each
Total weight:	0.04	MT

c. Description: breach roadblock to allow passage of vehicles.

d. Additional information: none.

14. Make assault crossing.

a. Required information: number of assault crossings; length of time AVLBs will be in place; location.

b. Resource requirements per crossing:

(1) Squad hr: none.

(2) Equipment hr:

- AVLB (bridge) 0.1 + time in place

(3) Total logistical weight: none.

c. Description: use an AVLB to make an assault crossing.

d. Additional information: none.

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[11] *Quantification of Mobility-Countermobility-Survivability Operations.*

APPENDIX G:

RESOURCE REQUIREMENTS FOR COUNTERMOBILITY TASKS--DETAILED ESTIMATE

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1. RCD--deliberate road crater.[72]

   a. Required information: number of RCDs; location.

   b. Resource requirements per RCD using cratering charges and one of the following four methods:

      (1) Shaped charges w/mines

         (a) Squad hr: 2.0.

         (b) Equipment hr: none.

         (c) Logistics:

- 18-kg (40 lb) shaped charges	6 ea	141.8 kg
- 18-kg (40 lb) cratering charges	10 ea	236.4 kg
- 0.5-kg (1 lb) blocks TNT	2 ea	1.0
- Detonating cord	92 m	
- Nonelectric blasting caps	21 ea	
- M700 Time fuse	9 m	
- Fuse lighters	3 ea	
- M21 AT mines	6 ea	49.0 kg
- M16 AP mines	6 ea	22.4 kg

Total weight: 0.45 MT

      (2) Shaped charges wo/mines

         (a) Squad hr: 1.5.

         (b) Equipment hr: none.

         (c) Logistics:

- 18-kg (40 lb) shaped charges	6 ea	141.8 kg
- 18-kg (40 lb) cratering charges	10 ea	236.4 kg
- 0.5-kg (1 lb) blocks TNT	2 ea	1.0
- Detonating cord	92 m	
- Nonelectric blasting caps	21 ea	
- M700 Time fuse	9 m	
- Fuse lighters	3 ea	

Total weight: 0.38 MT

      (3) Auger w/mines

         (a) Squad hr: 3.5.

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[72] FM 5-102, p 108, 191; *Countermobility* (HQDA, March 1985), *EFOSS*, pp N-III-g-1 through N-III-g-10; *Quantification of Mobility-Countermobility-Survivability Operations.*

(b) Equipment hr:

- JD 410 backhoe w/auger	3.0

(c) Logistics:

- 18-kg (40 lb) cratering charges	10 ea	236.4 kg
- 0.5-kg (1 lb) blocks TNT	2 ea	1.0 kg
- Detonating cord	92 m	
- Nonelectric blasting caps	21 ea	
- M700 time fuse	9 m	
- Fuse lighters	3 ea	
- M21 AT mines	6 ea	49.0 kg
- M16 AP mines	6 ea	22.4 kg

Total weight: 0.31 MT

(4) Auger w/o mines

(a) Squad hr: 3.0.

(b) Equipment hr:

- JD 410 backhoe w/auger	3.0

(c) Logistics:

- 18-kg (40 lb) cratering charges	10 ea	236.4 kg
- 0.5-kg (1 lb) blocks TNT	2 ea	1.0 kg
- Detonating cord	92 m	
- Nonelectric blasting caps	21 ea	
- M700 Time fuse	9 m	
- Fuse lighters	3 ea	

Total weight: 0.24 MT

c. Description: approximately 12.2 m end to end, 7.6 m wide, 2.4 m deep, V-shaped.

d. Additional information: road is 7.6 m wide with 2.4-m shoulders on each side. Dig alternating holes, two 1.5 m and four 2 m deep. Fill the 1.5-m-deep holes with 36 kg explosive and the 2.0-m-deep holes with 18 kg explosive. Prime all holes with 2 lb TNT. Shaped charges are used to blow the boreholes.

2. RCH--hasty road crater.[73]

a. Required information: number of RCHs; location.

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[73] FM 5-102, p 108, 191; *EFOSS*, N-III-g-1 through N-III-g-10; *Quantification of Mobility-Countermobility-Survivability Operations.*

b. Resource requirements per RCH using cratering charges and one of the following four methods:

(1) Shaped charges w/mines

(a) Squad hr: 2.0.

(b) Equipment hr: none.

(c) Logistics:

- 18-kg (40 lb) shaped charges	6 ea	141.8 kg
- 18-kg (40 lb) cratering charges	6 ea	141.8 kg
- 0.5-kg (1 lb) blocks TNT	60 ea	27.3 kg
- Detonating cord	92 m	
- Nonelectric blasting caps	15 ea	
- M700 Time fuse	9 m	
- Fuse lighters	3 ea	
- M21 AT mines	6 ea	49.0 kg
- M16 AP mines	6 ea	22.4 kg

Total weight: 0.38 MT

(2) Shaped charges wo/mines

(a) Squad hr: 1.5.

(b) Equipment hr: none.

(c) Logistics:

- 18-kg (40 lb) shaped charges	6 ea	141.8 kg
- 18-kg (40 lb) cratering charges	6 ea	141.8 kg
- 0.5-kg (1 lb) blocks TNT	60 ea	27.3 kg
- Detonating cord	92 m	
- Nonelectric blasting caps	15 ea	
- M700 time fuse	9 m	
- Fuse lighters	3 ea	

Total weight: 0.31 MT

(3) Auger w/mines

(a) Squad hr: 3.5.

(b) Equipment hr:

- JD 410 backhoe w/auger	3.0

(c) Logistics:

- 18-kg (40 lb) cratering charges	6 ea	141.8 kg
- 0.5-kg (1 lb) blocks TNT	60 ea	27.3 kg
- Detonating cord	92 m	

- Nonelectric blasting caps	15 ea	
- M700 time fuse	9 m	
Fuse lighters	3 ea	
- M21 AT mines	6 ea	49.0 kg
M16 AP mines	6 ea	22.4 kg

Total weight: 0.24 MT

(4) Auger wo/mines

(a) Squad hr: 3.0.

(b) Equipment hr:

- JD 410 backhoe w/auger	3.0

(c) Logistics:

- 18-kg (40 lb) cratering charges	6 ea	141.8 kg
0.5-kg (1 lb) blocks TNT	60 ea	27.3 kg
- Detonating cord	92 m	
- Nonelectric blasting caps	15 ea	
- M700 time fuse	9 m	
- Fuse lighters	3 ea	

Total weight: 0.17 MT

c. Description: approximately 12.2 m end to end, 6.1 to 7.6 m wide, 1.8 to 2.1 m deep, V-shaped.

d. Additional information: road is 7.6 m wide with 2.4-m shoulders on each side.

3. RCM--road crater with M180.[74]

a. Required information: number of RCMs; location.

b. Resource requirements per RCM using M180 cratering charges either with mines or without mines:

(1) w/mines

(a) Squad hr: 1.0.

(b) Equipment hr: none.

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[74] FM 5-102, p 108, 191; *EFOSS*, N-III-g-1 through N-III-g-10; *Quantification of Mobility, Countermobility, Survivability Operations.*

(c) Logistics:

- M180 kits	5 ea	375.0 kg
- M21 AT mines	6 ea	49.0 kg
- M16 AP mines	6 ea	22.4 kg

Total weight: 0.45 MT

(2) wo/mines

(a) Squad hr: 0.5.

(b) Equipment hr: none.

(c) Logistics:

- M180 kits	5 ea	375.0 kg

Total weight: 0.38 MT

c. Description: relieved faced 9.1 m long, 5.5 m wide, and 2.4 m deep.

d. Additional information: blasting cap machine required.

4. RCR--relieved face road crater.[75]

a. Required information: number of RCRs.

b. Resource requirements per RCR using cratering charges and one of the following four methods:

(1) Shaped charges w/mines

(a) Squad hr: 2.5.

(b) Equipment hr: none.

(c) Logistics:

- 18-kg (40 lb) shaped charges	11 ea	260.0 kg
- 18-kg (40 lb) cratering charges	6 ea	141.8 kg
- 0.5-kg (1 lb) blocks TNT	156 ea	70.9 kg
- Detonating cord	92 m	
- Nonelectric blasting caps	36 ea	
- M700 time fuse	9 m	
- Fuse lighters	3 ea	
- M21 AT mines	6 ea	49.0 kg
- M16 AP mines	6 ea	22.4 kg

Total weight: 0.47 MT

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[75] FM 5-102, p 108, 191; *EFOSS*, pp N-III-g-1 through N-III-g-10; *Quantification of Mobility-Countermobility-Survivability Operations.*

(2) Shaped charges wo/mines

(a) Squad hr: 2.0.

(b) Equipment hr: none.

(c) Logistics:

- 18-kg (40 lb) shaped charges	11 ea	260.0 kg
- 18-kg (40 lb) cratering charges	6 ea	141.8 kg
- 0.5-kg (1 lb) blocks TNT	156 ea	70.9 kg
- Detonating cord	92 m	
- Nonelectric blasting caps	36 ea	
- M700 time fuse	9 m	
- Fuse lighters	3 ea	

Total weight: 0.40 MT

(3) Auger w/mines

(a) Squad hr: 4.5.

(b) Equipment hr:

- JD 410 backhoe w/auger	4.0

(c) Logistics:

- 18-kg (40 lb) cratering charges	6 ea	141.8 kg
- 0.5-kg (1 lb) blocks TNT	156 ea	70.9 kg
- Detonating cord	92 m	
- Nonelectric blasting caps	36 ea	
- M700 time fuse	9 m	
- Fuse lighters	3 ea	
- M21 AT mines	6 ea	49.0 kg
- M16 AP mines	6 ea	22.4 kg

Total weight: 0.28 MT

(4) Auger wo/mines

(a) Squad hr: 4.0.

(b) Equipment hr:

- JD 410 backhoe w/auger	4.0

(c) Logistics:

- 18-kg (40 lb) cratering charges	6 ea	141.8 kg
- 0.5-kg (1 lb) blocks TNT	156 ea	70.9 kg
- Detonating cord	92 m	
- Nonelectric blasting caps	36 ea	

- M700 time fuse	9 m
- Fuse lighters	3 ea

Total weight: 0.21 MT

c. Description: Approximately 12.2 m end to end, 7.6 to 9.1 m wide, 2.1 m deep, trapezoidal-shaped with unequal side slopes.

d. Additional information: Road width is 7.6 m with 2.4 m shoulders on each side. Two rows of charges 2.4 m apart. The holes in the row on the friendly side are spaced 2.1 m and are 1.5 m deep filled with 18.2 kg (40 lb) cratering charges. The holes in the row on the enemy side are staggered in relation to the friendly row and are 1.2 m deep with 21.9 kg of TNT. The cratering charges are dual primed with 0.5 kg blocks of TNT. A more effective crater can be created using electrical primed charges with a 1 - 1+ second delay in firing the friendly side row of cratering charges.

5. BRA--blow bridge, Type A.[illegible]

a. Required information: number of Type A bridges; location.

b. Resource requirements per major bridge for superstructure only or superstructure and substructure:

(1) Destroy superstructure

(a) Squad hr: 3.0.

(b) Equipment hr: none.

(c) Logistics:

- C4 explosives	91 kg	
- Detonating cord	610 m	
- Nonelectric blasting caps	36 ea	
- Time fuse	8 m	
- Fuse lighters	4 ea	
- M15 AT mines	12 ea	163.3 kg
- M16 AP mines	12 ea	43.7 kg

Total weight: 0.30 MT

(2) Destroy superstructure and substructure

(a) Squad hr: 5.0.

(b) Equipment hr: none.

(c) Logistics:

[illegible] *EFOSS*, p N-III-e-1 through N-III-e-5; *Quantification of Mobility-Countermobility-Survivability Operations*; FM 5-25, *Explosives and Demolitions* (HQDA, February 1971), pp 4-30 through 4-50.

18-kg (40 lb) shaped charges	11 ea	260.0 kg
18-kg (40 lb) cratering charge	11 ea	260.0 kg
0.5-kg (1 lb) block of TNT	11 ea	5.0 kg
C4 explosives		91.0 kg
Detonating cord	746 m	
Nonelectric blasting caps	72 ea	
Time fuse	17 m	
Fuse lighters	7 ea	
M15 AT mines	12 ea	163.3 kg
M16 AP mines	12 ea	43.7 kg

Total weight: 0.82 MT

c. Description: major four-lane highway bridge, abutment 18 m wide.

d. Additional information: The above resource requirements are for cutting both ends of a superstructure with sixteen 36WF160 stringers and for destroying the friendly abutment which is assumed to be less than 1.5 m thick. 18-kg (40 lb) cratering charges are placed 1.5 m from abutment into the embankment, 1.5 m deep, and spaced 1.5 m (triple-nickel-forty method). Eighteen-kg (40 lb) shaped charges used to bore holes. These may be substituted with 15 lb shaped charges with the appropriate stand-off.

6. BRB--blow primary bridge, Type B.[17]

a. Required information: number of Type B bridges; location.

b. Resource requirements per primary bridge for superstructure only or superstructure and substructure:

(1) Destroy superstructure

(a) Squad hr: 2.0.

(b) Equipment hr: none.

(c) Logistics:

- C4 explosives		82.0 kg
- Detonating cord	305 m	
- Nonelectric blasting caps	4 ea	
- Time fuse	15 m	
- Fuse lighters	4 ea	
- M15 AT mines	6 ea	81.7 kg
- M16 AP mines	6 ea	21.8 kg

Total weight: 0.19 MT

FFOSS, pp N-III-e-1 through N-III-e-5; *Quantification of Mobility-Countermobility-Survivability Operations*; FM 5-25, *Explosives and Demolitions* (HQDA, February 1971), pp 4-30 through 4-50.

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(2) Destroy superstructure and substructure

(a) Squad hr: 3.5.

(b) Equipment hr: none.

(c) Logistics:

- 18 kg (40 lb) shaped charges	5 ea	118.2 kg
- 18 kg (40 lb) cratering charge	5 ea	118.2 kg
- 0.5 kg (1 lb) block of TNT	5 ea	2.3 kg
- C4 explosives		82.0 kg
- Detonating cord	396 m	
- Nonelectric blasting caps	21 ea	
- Time fuse	24 m	
- Fuse lighters	7 ea	
- M15 AT mines	6 ea	81.7 kg
- M16 AP mines	6 ea	21.8 kg

Total weight: 0.42 MT

c. Description: primary two-lane highway bridge, abutment 9 m wide.

d. Additional information: The above resource requirements are for cutting both ends of a superstructure with eight concrete T-beams AFT depth and for destroying the friendly abutment which is assumed to be less than 1.5 m thick. 18-kg (40 lb) cratering charges are placed 1.5 m from abutment into the embankment, 1.5 m deep, and spaced 1.5 m (Triple-nickel-forty method). 18-kg (40 lb) shaped charges used to bore holes. These may be substituted with 15 lb shaped charges with the appropriate stand-off.

7. BRC--blow bridge, Type C.[*]

a. Required information: number of Type C bridges; location.

b. Resource requirements per secondary bridge for superstructure only or superstructure and substructure:

(1) Destroy superstructure

(a) Squad hr: 1.0.

(b) Equipment hr: none.

(c) Logistics:

- C4 explosives		23.0 kg
- Detonating cord	1524 m	
- Nonelectric blasting caps	4 ea	

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[*] *EFOSS*, pp N-III-e-1 through N-III-e-5; *Quantification of Mobility-Countermobility-Survivability Operations*; FM 5-25, Explosives and Demolitions (HQDA, February 1971), pp 4-30 through 4-50.

- Time fuse	8 m	
- Fuse lighters	4 ea	
- M15 AT mines	6 ea	81.7 kg
- M16 AP mines	6 ea	21.8 kg

Total weight: 0.13 MT

(2) Destroy superstructure and substructure

(a) Squad hr: 2.5.

(b) Equipment hr: none.

(c) Logistics:

- 18-kg (40 lb) shaped charges	5 ea	118.2 kg
- 18-kg (40 lb) cratering charge	5 ea	118.2 kg
- 0.5-kg (1 lb) block of TNT	5 ea	2.3 kg
- C4 explosives		23.0 kg
- Detonating cord	1615 m	
- Nonelectric blasting caps	21 ea	
- Time fuse	17 m	
- Fuse lighters	7 ea	
- M15 AT mines	6 ea	81.7 kg
- M16 AP mines	6 ea	21.8 kg

Total weight: 0.37 MT

c. Description: secondary two-lane highway bridge, abutment 18 m wide.

d. Additional information: The above resource requirements are for cutting both ends of a superstructure with five 10 W 112 stringers and for destroying the friendly abutment which is assumed to be less than 1.5 m thick. 18-kg (40 lb) cratering charges are placed 1.5 m from abutment into the embankment, 1.5 m deep, and spaced 1.5 m (Triple-nickel-forty method). 18-kg (40 lb) shaped charges used to bore holes. These may be substituted with 15 lb shaped charges with the appropriate stand-off.

8. ABT—construct an abatis.[79]

a. Required information: total meters of abatis; location.

b. Resource requirements per abatis (100 m):

(1) Squad hr: 2.

(2) Equipment hr: none.

(3) Logistics:

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[79] FM 5-102, p 126, 194; *EFOSS*, N-III-j-1 through N-III-j-7; *Quantification of Mobility-Countermobility-Survivability Operations.*

● TNT	130 ea	59.1 kg
● Detonating cord	600 m	17.8 kg
● Nonelectric blasting caps	22 ea	
● Time fuse	6 m	
● Fuse lighters	2 ea	

Total weight: 0.08 MT.

c. Description: trees (40 cm diameter) are spaced 10 m apart on each side of roadway, for 20 trees per 100 m abatis.

d. Additional information: none.

9. ATD--construct an antitank ditch.[80]

a. Required information: total meters of ATD, type of soil (clay or sand), and location.

b. Resource requirements per 100 m of antitank ditch using one of two classes of equipment:

(1) A team of D7 dozer, ACE, or CEV or one of the three and a 2.5 cu yd scoop loader

(a) Squad hr: none.

(b) Equipment hr:

* sand	
- D7 dozer, ACE, or CEV	1.5
- 2.5 cu yd scoop loader	1.5
- M916 tractor w/trailer	1.5
* clay	
- D7 dozer, ACE, or CEV	2.0
- 2.5 cu yd scoop loader	2.0
- M916 tractor w/trailer	2.0

(c) Total logistical weight: none.

(2) A team of T5 dozers or a T5 dozer and a 2.5 cu yd scoop loader

(a) Squad hr: none.

(b) Equipment hr:

* sand	
- T5 dozer	2.3
- 2.5 cu yd scoop loader	2.3
- M916 tractor w/trailer	1.2
* clay	

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[80] FM 5-102, p 116-125; *EFOSS*, pp N-III-h-1 through N-III-i-8; *Quantification of Mobility-Countermobility-Survivability Operations*.

- T5 dozer	3.0
- 2.5 cu yd scoop loader	3.0
- M916 tractor w/trailer	1.5

(c) Total logistical weight: none.

c. Description: either a rectangular or triangular ditch 1.5 m deep by 3.3 m wide.

d. Additional information: use equipment in teams in "T-push" configuration. In sand rectangular ditches should be increased in depth to 1.6 m and triangular ditches should be increased to 1.8 m.

10. WBT--general-purpose barbed-tape obstacle (GPBTO).[81]

a. Required information: total meters of WBT; location.

b. Resource requirements per 300 m WBT: eight GPBTO packages.

(1) Squad hr: 0.13.

(2) Equipment hr: one 2.5-ton cargo truck = 0.13.

(3) Total weight: 0.94 MT.

c. Description: three coils placed side by side on the ground, 300 m long.

d. Additional information: estimate is based on vehicular emplacement.

11. WTC--triple standard concertina.[82]

a. Required information: total meters of WTC; location.

b. Resource requirements per 300 m WTC:

(1) Squad hr: 3.

(2) Equipment hr: one 2.5-ton truck = 1.

(3) Logistics

- 2.5 ton truck	1 ea
- long pickets	4 ea
- short pickets	4 ea
- reels of barbed tape	4 ea
- coils barbed-tape concertina	56 ea

Total weight: 2.19 MT.

c. Description: two coils of concertina are placed side by side with a third coil placed on top.

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[81] *Quantification of Mobility-Countermobility-Survivability Operations.*

[82] FM 5-102, p 193; *Quantification of Mobility-Countermobility-Survivability Operations.*

d. Additional information: picket spacing--long pickets are five meters apart, short pickets are two meters from the end of long pickets and used to anchor the horizontal wire. There are two rows of long pickets 1 m apart.

12. WRC--nonstandard concertina roadblock.[83]

a. Required information: number of WRCs; location.

b. Resource requirements per roadblock:

(1) Squad hr: 1.

(2) Equipment hr: one 2.5-ton truck = 1.

(3) Logistics

- 2.5 ton truck	1 ea
- long pickets	30 ea
- short pickets	22 ea
- coils barbed-tape concertina	11 ea
- barbed tape	275 m (or 5.5 reels @ 50 m/reel)

Total weight: 0.43 MT.

c. Description: one roadblock consists of 11 coils placed side by side, three long pickets per coil, five paces apart, horizontal wire placed on top of each coil, and short pickets used to anchor horizontal wire.

d. Additional information: as roadblocks, several coils of barbed-tape concertinas laid side by side will impede movement of vehicles. A series of these roadblocks should be placed about 10 m apart.

13. MFAT--RAAMS, artillery delivered AT minefield.[84]

a. Required information: mine density/m^2 (0.001, 0.002, 0.004); whether low-angle fire (area covered 200 m by 200 m) or high-angle fire (area covered 400 m by 400 m); number of minefields at that density and angle of fire; location.

b. Resource requirements per minefield:

(1) Squad hr: none.

(2) Equipment hr: none.

(3) Logistics

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[83] FM 5-102, p 194; *Quantification of Mobility-Countermobility-Survivability Operations.*
[84] FM 5-102, p 185; *Quantification of Mobility-Countermobility-Survivability Operations.*

	Density (mines/m^2)	Artillery Rounds
High-angle	0.001	24
	0.002	48
	0.004	96

	Density (mines/m^2)	Artillery Rounds
Low-angle	0.001	6
	0.002	12
	0.004	24.

c. Description: remote antiarmor mine system (RAAMS), artillery delivered antitank minefield. Low-angle fire area covered 200 m by 200 m; high-angle fire area covered 400 m by 400 m.

d. Additional information: each round contains nine AT mines. No engineer resources are used.

14. MFAP--ADAM, artillery delivered AP minefield.[85]

a. Required information: mine density/m^2 (0.005, 0.001, 0.002); number of minefields (area covered 400 m by 400 m) at that density; location.

b. Resource requirements per minefield:

(1) Squad hr: none.

(2) Equipment hr: none.

(3) Logistics

Density (mines/m^2)	Artillery Rounds
0.0005	3
0.001	6
0.002	12

c. Description: area denial artillery munition (ADAM), artillery delivered AP minefield. High-angle fire only, area covered 400 m by 400 m.

d. Additional information: each round contains 36 AP mines.

15. MFGT--minefield, GEMSS (AT only).[86]

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[85] FM 5-102, p 185.

[86] FM 5-102, p 185; *EFOSS*, pp N-III-c-1 through N-III-d-9; *Quantification of Mobility-Countermobility-Suervivability Operations.*

a. Required information: total meters of front (assume one 60 m wide belt, multiply minefield width by number of belts to allow for more than one belt); density (0.001, 0.005, 0.007, 0.01, 0.025 mines/m^2).

b. Resource requirements per minefield: the effort and mine belt length for an 800-mine load fully dispensed as a function of the minefield density (60 m belt assumed, double the length if 30 m belts are used) is given below:

Density (mines/m^2)	0.001	0.005	0.007	0.01	0.025
Length (m)	13333	2666	1904	1333	533
Effort (squad hr)	2.24	0.45	0.32	0.22	0.09

Given the density and total meters of front, the number of 800-mine loads

$$= \frac{\text{Length of mine front}}{\text{Belt length for given density}}$$

(1) Squad hr = number of 800-mine loads (do not round) x Effort for the given density

+ Number of 800-mine loads (round to next higher integer) x 0.4 hr

(2) GEMSS hr: equal to squad hr.

(3) Logistics

Number of mines = Number of 800-mine loads x 800.
Total weight = Number of mines x 1.72 kg.

c. Description: tactical AT minefield with variable densities emplaced with a Ground Emplaced Mine Scattering System (GEMSS) using M75 AT mines. Single belt can be 30 m or 60 m wide.

d. Additional information: two 60 m belts separated by 40 m are recommended. Three 60 m belts are optimum. A density of 0.005 mines/m is recommended. A primary mover is required but not included in the resource calculations. Effort is based on laying and reload time. Additional time should be planned for marking as required.

16. MFGP--minefield, GEMSS (AP only).[87]

a. Required information: total meters of front (assume one 60 m wide belt, multiply minefield width by number of belts to allow for more than one belt); density (0.001, 0.005, 0.007, 0.01, 0.025 mines/m^2).

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[87] FM 5-102, p 186; *EFOSS*, pp *N-III-c-1 through N-III-d-9; Quantification of Mobility-Countermobility-Survivability Operations.*

b. Resource requirements per minefield: The effort and mine belt length for an 800-mine load fully dispensed as a function of the minefield density (60 m belt assumed, double the length if 30 m belts are used) is given below:

Density (mines/m^2)	0.001	0.005	0.007	0.010.025
Length (m)	13333	2666	1904	1333533
Effort (squad hr)	2.24	0.45	0.32	0.220.09

Given the density and total meters of front the number of 800-mine loads $= \dfrac{\text{Length of mine front}}{\text{Belt length for given density}}$

(1) Squad hr = number of 800-mine loads (do not round) x Effort for the given density

+ Number of 800-mine loads (round to next higher integer) x 0.4 hr

(2) GEMSS hr: equal to squad hr.

(3) Logistics

Number of mines = Number of 800-mine loads x 800.
Total weight = Number of minex x 1.45 kg.

c. Description: tactical AP minefield with variable densities emplaced with a Ground Emplaced Mine Scattering System (GEMSS) using M74 AP mines. Single belt can be 30 m or 60 m wide.

d. Additional information: two 60 m belts separated by 40 m are recommended. Three 60 m belts are optimum. A density of 0.005 mines/m is recommended. A primary mover is required but not included in the resource calculations. Effort is based on laying and reload time. Additional time should be planned for marking as required.

17. MFGM--minefield, GEMSS mixed (AT and AP).[88]

a. Required information: total meters of front (assume one 60 m wide belt, multiply minefield width by number of belts to allow for more than one belt); density (0.001, 0.005, 0.007, 0.01, 0.025 mines/m); ratio of AT mines to AP mines (AT:AP).

b. Resource requirements per minefield: the effort and mine belt length for an 800-mine load fully dispensed as a function of the minefield density (60 m belt assumed, double the length if 30 m belts are used) is given below:

Density (mines/m^2)	0.0017	0.005	0.007	0.01	0.025
Length	13333	2666	1904	1333	533
Effort (squad hr)	2.24	0.45	0.32	0.22	0.09

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[88] FM 5-102, p 186; *EFOSS*, pp N-III-c-1 through N-III-d-9; *Quantification of Mobility-Countermobility-Survivability Operations.*

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Given the density and total meters of front, the number

$$\text{of 800-mine loads} = \frac{\text{Length of mine front}}{\text{Belt length for given density}}$$

(1) Squad hr = number of 800 mine loads (do not round) x Effort for the given density

+ Number of 800-mine loads (round to next higher integer) x 0.4 hr

(2) GEMSS hr: equal to squad hr.

(3) Logistics

Number of mines = Number of 800-mine loads x 800.

$$\text{Number of AT mines} = \text{total mines} \times \frac{\text{AT}}{\text{AT} + \text{AP}}.$$

Number of AP mines = total mines - AT mines.

Total weight = AT mines x 1.72 kg + AP mines x 1.45 kg.

c. Description: tactical minefield with variable densities emplaced with a Ground Emplaced Mine Scattering System (GEMSS) using a mix of M75 AT and M74 AP mines. Single belt can be 30 m or 60 m wide.

d. Additional information: two 60 m belts separated by 40 m are recommended. Three 60 m belts are optimum. Recommended ratio of AT mines to AP mines is 5:1 with a density of 0.005 mines/m. A primary mover is required but not included in the resource calculations. Effort is based on laying and reload time. Additional time should be planned for marking as required.

18. MFMT--minefield, MOPMS, AT.[89]

a. Required information: number of MOPMS AT packs; location.

b. Resource requirements per pack:

(1) Squad hr: 0.3.

(2) Equipment hr: none.

(3) Logistics: one pack XM 132 AT packs

Total weight: 0.07 MT.

c. Description: modular pack mine system (MOPMS). Each pack disperses 21 mines in a semicircle with a 35-m radius at a density of 0.01 mines/m^2.

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[89] FM 5-102, p 187, EFOSS, pp N-III-a-1 through N-III-a-5; *Quantification of Mobility-Countermobility-Survivability Operations.*

d. Additional information: greater densities can be obtained by overlapping the dispensing pattern. An MOPMS contains only AP or AT mines. A mixed minefield can be obtained by overlapping patterns of each type. If a mixed minefield is used, fire AP last. This will prevent the AT mines from landing on the AP mine tripwires and detonating the AT mines prematurely.

19. MFMP--minefield, MOPMS, AP.[90]

a. Required information: number of MOPMS AP packs; location.

b. Resource requirements per pack:

(1) Squad hr: 0.3.

(2) Equipment hr: none.

(3) Logistics: one pack XM 131 AP packs.

Total weight: 0.07 MT.

c. Description: modular pack mine system (MOPMS). Each pack disperses 21 mines in a semicircle with a 35-m radius at a density of 0.01 mines/m^2.

d. Additional information: greater densities can be obtained by overlapping the dispensing pattern. An MOPMS contains only AP or AT mines. A mixed minefield can be obtained by overlapping patterns of each type. If a mixed minefield is used, fire AP last. This will prevent the AT mines from landing on the AP mine tripwires and detonating the AP mines prematurely.

20. MFH--M56 helicopter delivered AT mines.[91]

a. Required information: number of M56 sorties; location.

b. Resource requirements:

(1) Squad hr: none.

(2) Equipment hr: none.

(3) Logistics: M56 helicopter sorties.

c. Description: one sortie delivers 20 m by 1600 m at 0.005 mines/m^2 or 20 m by 800 m at 0.01 mines/m^2.

d. Additional information: no engineer resources are used.

21. MFAF--GATOR, USAF delivered scatterable mines.[92]

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[90] FM 5-102, p 187; *EFOSS*, pp N-III-a-1 through N-III-a-5; *Quantification of Mobility-Countermobility-Survivability Operations.*

[91] FM 5-102, p 188; *Quantification of Mobility-Countermobility-Survivability Operations.*

[92] FM 5-102, p 188.

a. Required information: number of canisters; location.

b. Resource requirements:

(1) Squad hr: none.

(2) Equipment hr: none.

(3) Logistics: GATOR canisters as required.

c. Description: USAF delivered scatterable mines.

d. Additional information: each canister contains 72 AT and 22 AP mines. Density depends on the number of canisters dropped. Area of minefield depends on the speed and altitude of the aircraft. Engineer resources are not used.

22. MFD--M57 antitank mine dispensing system.[93]

a. Required information: total meters of front (0.5 AT mines/m front); location.

b. Resource requirements per 500 m front: 275 M15 mines.

(1) Squad hr: 6.3.

(2) Equipment hr:

M57 = 2.1.
- One 2.5 ton truck = 2.1

(3) Logistics:

- M15 AT mines	275 ea

Total weight: 3.88 MT.

c. Description: minefield is 50 m deep.

d. Additional information: laying speed is 1 to 3 mph depending on terrain. A limitation is the speed of the two personnel standing in the truck loading the mines. Surface laying does not reduce time. It is recommended that an antipersonnel minefield with a density of 0.5 mines/m front be emplaced in the same area as the M57 minefield. A 5-ton dump truck will hold 288 racked mines.

23. MFJ--standard minefield (density* = 0.5-0.5-0).[94]

a. Required information: minefield front length (m); location.

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[93] FM 5-102, p 189; *EFOSS*, pp N-III-e-1 through N-III-e-13; FM 90-7, p F-4; *Quantification of Mobility-Countermobility-Survivability Operations.*
*Mines/m front, antitank; antipersonnel fragment: antipersonnel blast.
[94] FM 20-32, *Mine/Countermine Operations at the Company Level* (HQDA, November 1976).

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b. Resource requirements per minefield: total number of mines, where L = front length in meters, is calculated as follows.

$$1.1 \times \frac{(0.5\ L)}{9} + 0.5\ L = \text{AT total}$$

(Note: M21 AT mines are used.)

$$1.1 \times \frac{(0.5\ L)}{9} + 0.5\ L = \text{APF total}$$

(Note: M16 APF mines are used.)

(1) Squad hr:

Manhours-

$$\frac{\text{AT total}}{4} \text{ (from above)} = \text{AT manhours (MH)}$$

$$\frac{\text{APF total}}{8} = \text{APF manhours (MH).}$$

$$\text{sq hr} = \frac{\text{AT MH + APF MH}}{8}.$$

(2) Equipment hr: none.

(3) Logistics

- M21 AT mines = AT total @ 8.16 kg/mine
- M16 AP mines = APF total @ 3.74 kg/mine
- Total Weight = Sum of AT + AP

c. Description: hand-emplaced minefield.

d. Additional information: assume mines are onsite. IOE representative cluster composition is the same as the density. Round all numbers to the next highest integer. Meters are used as the unit of measurement during installation.

24. MFK--standard minefield (density = 1-1-1).[95]

a. Required information: minefield front length (m); location.

b. Resource requirements per minefield: total number of mines, where L = front length in meters, is calculated as follows.

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[95] FM 20-32.

$$1.1 \times \frac{(L + L)}{9} = \text{AT total}$$

(Note: M21 AT mines are used.)

$$1.1 \times \frac{(L + L)}{9} = \text{APF total}$$

(Note: M16 APF mines are used.)

$$1.1 \times \frac{(L + L)}{9} = \text{APB total}$$

(Note: M14 APB mines are used.)

(1) Squad hr:

$$\frac{\text{AT total}}{4} = \text{AT manhours (MH)}$$

$$\frac{\text{APF total}}{8} = \text{APF manhours (MH)}$$

$$\frac{\text{APB total}}{16} = \text{APB manhours}$$

$$\text{sq hr} = \frac{\text{AT MH} + \text{APF MH} + \text{APB MH}}{8}$$

(2) Equipment hr: none.

(3) Logistics:

Manhours--

M21 AT mines = AT total @ 8.16 kg
M16 APF mines = APF total @ 3.74 kg
M14 APB mines = APB total @ 0.1 kg
Total weight = sum of AT, APF, and APB.

c. Description: hand-emplaced minefield.

d. Additional information: assume mines are onsite. IOE representative cluster composition is the same as the density. Round all numbers to the next highest integer. Meters are used as the unit of measurement during installation.

APPENDIX H:

RESOURCE REQUIREMENTS FOR SURVIVABILITY TASKS—DETAILED ESTIMATE

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1. Deliberate fighting position, M1/M60 tank.[96]

   a. Required information: number of deliberate fighting positions for tanks and type of equipment used.

   b. Resource requirements per deliberate position using one of two classes of equipment:

      (1) D7 Dozer, ACE or CEV
      Equipment hr:

- D7 dozer, ACE, or CEV	1.50
- M916 tractor w/trailer (D7 only)	1.50

      (2) T5 Dozer
      Equipment hr:

- T5 dozer	2.25
- M916 tractor w/trailer	1.13

   c. Description: excavate a primary, secondary, or alternate deliberate turret defilade position for an M1, M60, or M48 tank.

   d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

2. Protective fighting position, tank.[97]

   a. Required information: number of deliberate fighting positions for M2s and M3s and type of equipment used.

   b. Resource requirements per deliberate position using one of two classes of equipment:

      (1) D7 Dozer, ACE or CEV

      Equipment hr:

- D7 dozer, ACE, or CEV	1.20
- M916 tractor w/trailer (D7 only)	1.20

      (2) T5 Dozer

      Equipment hr:

- T5 dozer	1.80
- M916 tractor w/trailer	0.90

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[96] EFOSS, pp N-III-q-1 through N-III-s-2; *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.

[97] EFOSS; *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.

c. Description: excavate a primary, secondary, or alternate deliberate turret defilade position for an M2 or M3 fighting vehicle.

d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

3. Protective fighting position, VULCAN (towed).

a. Required information: number of deliberate fighting positions for M113 chassis vehicles and type of equipment used.

b. Resource requirements per deliberate position using one of two classes of equipment:

(1) D7 Dozer, ACE or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	0.70
- M916 tractor w/trailer (D7 only)	0.70

(2) T5 Dozer

Equipment hr:

- T5 dozer	1.05
- M916 tractor w/trailer	0.53

c. Description: excavate a primary, secondary, or alternate deliberate turret defilade position for an M113 chassis vehicle to include Improved TOW Vehicles, Mortar carriers, and Vulcans.

d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

4. Protective fighting position, 105-mm Howitzer, towed (Infantry Division).

a. Required information: number of protective positions for self-propelled howitzers and type of equipment used.

b. Resource requirements per protective position using one of two classes of equipment:

(1) D7 Dozer, ACE or CEV

Equipment hr:

U.S. Army Engineer Assessment, Europe (U) Vol II, Figure B-1-11.

U.S. Army Engineer Assessment, Europe (U), Vol II, Figure B-1-11.

- D7 dozer, ACE, or CEV	2.50
- M916 tractor w/trailer (D7 only)	2.50

(2) T5 Dozer

Equipment hr:

- T5 dozer	3.75
- M916 tractor w/trailer	1.88

c. Description: excavate a protective position for a self-propelled howitzer and ammo carrier. Position provides approximately 1 m clearance around the vehicle for maintenance.

d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

5. Protective fighting position, 105-mm Howitzer, towed (Airborne Division).[100]

a. Required information: number of protective positions for towed howitzers and type of equipment used.

b. Resource requirements per protective position using one of two classes of equipment:

(1) D7 Dozer, ACE or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	0.30
- M916 tractor w/trailer (D7 only)	0.30

(2) T5 Dozer

Equipment hr:

- T5 dozer	0.45
- M916 tractor w/trailer	0.23

c. Description: excavate a protective position for a towed howitzer.

d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

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[100] *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.

6. Protective fighting position, 105-mm Howitzer, towed (Air Mobile Division).

   a. Required information: number of deliberate positions for command post carriers and type of equipment used.

   b. Resource requirements per deliberate position using one of two classes of equipment:

      (1) D7 Dozer, ACE or CEV

      Equipment hr:

- D7 dozer, ACE, or CEV	0.80
- M916 tractor w/trailer (D7 only)	0.80

      (2) T5 Dozer

      Equipment hr:

- T5 dozer	1.20
- M916 tractor w/trailer	0.60

   c. Description: excavate a primary or alternate deliberate hull defilade position for a command post carrier.

   d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. If available a scoop loader can be used to haul the spoil away or pile near the emplacement to be camouflaged by occupying troops.

7. Protective fighting position, 155-mm Howitzer (towed).

   a. Required information: number of protective positions for support vehicles and type of equipment used.

   b. Resource requirements per protective position using one of two classes of equipment:

      (1) D7 Dozer, ACE or CEV

      Equipment hr:

- D7 dozer, ACE, or CEV	1.50
- M916 tractor w/trailer (D7 only)	1.50

      (2) T5 Dozer

      Equipment hr:

U.S. Army Engineer Assessment, Europe (U), Vol II, Figure B-1-11.

U.S. Army Engineer Assessment, Europe (U), Vol II, Figure B-1-11.

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- T5 dozer	2.25
- M916 tractor w/trailer	1.13

c. Description: excavate a deep-cut vehicle position to provide protection for support vehicles to include tracked recovery vehicles, cargo trucks, maintenance and computer vans, and POL transporters.

d. Additional information: excavation is assumed to be in loam. Reduce efficiency factor by 15 percent for rocky or hard soil. Above times are for an average of times for various support vehicles.

8. Berm for CHAPARRAL.

a. Required information: number of berms for CHAPARRAL; location.

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 Dozer, ACE or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	0.90
- M916 tractor w/trailer (D7 only)	0.90

(2) T5 Dozer

Equipment hr:

- T5 dozer	1.35
- M916 tractor w/trailer	0.68

c. Description: construct a berm for CHAPARRAL.

d. Additional information: none.

9. Berm for forward area alert radar (FAAR).[104]

a. Required information: number of berms for FAAR; location.

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 Dozer, ACE or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	0.90
- 2.5 cu yd scoop loader	0.90
- M916 tractor w/trailer (D7 only)	0.90

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[103] U.S. Army Engineer Assessment, Europe (U), Vol II, Figure B-1-11.
[104] U.S. Army Engineer Assessment, Europe (U), Vol II, Figure B-1-11.

(2) T5 Dozer

Equipment hr:

- T5 dozer	1.35
- 2.5 cu yd scoop loader	1.35
- M916 tractor w/trailer	0.68

c. Description: construct a berm for FAAR.

d. Additional information: none.

10. Berm for CB/CM radar (FA).

a. Required information: number of berms for CB/CM radar (FA); location.

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 Dozer, ACE or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	0.45
- M916 tractor w/trailer (D7 only)	0.45

(2) T5 Dozer

Equipment hr:

- T5 dozer	0.68
- M916 tractor w/trailer	0.34

c. Description: construct a berm for CB/CM radar (FA).

d. Additional information: none.

11. Berm for HAWK launcher.[106]

a. Required information: number of berms for HAWK launcher; location.

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 Dozer, ACE or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	2.10
- M916 tractor w/trailer (D7 only)	2.10

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[105] *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.
[106] *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.

(2) T5 Dozer

Equipment hr:

- T5 dozer	3.20
- M916 tractor w/trailer	1.60

c. Description: construct berm for HAWK launcher.

d. Additional information: none.

12. Berm for information coordination center (HAWK).

a. Required information: number of berms for information coordination center (HAWK); location.

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	0.60
- 2.5 cu yd scoop loader	0.60
- M916 tractor w/trailer (D7 only)	0.60

(2) T5 Dozer

Equipment hr:

- T5 dozer	0.90
- 2.5 cu yd scoop loader	0.90
- M916 tractor w/trailer	0.45

c. Description: construct a berm for a HAWK information coordination center.

d. Additional information: none.

13. Berm for PAR/ROR/CWAR/HIPIR (HAWK).

a. Required information: number of berms for PAR/ROR/CWAR/HIPIR (HAWK); location.

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	1.58
- M916 tractor w/trailer (D7 only)	1.58

(2) T5 Dozer

Equipment hr:

- T5 dozer	2.37
- M916 tractor w/trailer	1.19

c. Description: construct berm for PAR/ROR/CWAR/HIPIR (HAWK).

d. Additional information: none.

14. Berm for generator (HAWK).

a. Required information: number of berms for generator (HAWK); location.

b. Resource requirements per berm using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	1.13
- M916 tractor w/trailer (D7 only)	1.13

(2) T5 Dozer

Equipment hr:

- T5 dozer	1.70
- M916 tractor w/trailer	0.85

c. Description: construct a berm for a HAWK generator.

d. Additional information: none.

15. Cut slot for battery control center (HAWK).

a. Required information: number of slots for battery control (HAWK); location.

b. Resource requirements per cut slot using one of two classes of equipment:

(1) D7 Dozer, [illegible] or CEV

Equipment hr:

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[107] *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.
[108] *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.
[109] *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.
[110] *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.

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- D7 dozer, ACE, or CEV	1.80
- 2.5 cu yd scoop loader	1.80
- M916 tractor w/trailer (D7 only)	1.80

(2) T5 Dozer

Equipment hr:

- T5 dozer	2.70
- 2.5 cu yd scoop loader	2.70
- M916 tractor w/trailer	1.35

c. Description: excavate slot for HAWK battery control center.

d. Additional information: none.

16. Cut slot for platoon command post (HAWK).[111]

a. Required information: number of slots for platoon command post (HAWK); location.

b. Resource requirements per cut slot using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	0.60
- 2.5 cu yd scoop loader	0.60
- M916 tractor w/trailer (D7 only)	0.60

(2) T5 Dozer

Equipment hr:

- T5 dozer	0.90
- 2.5 cu yd scoop loader	0.90
- M916 tractor w/trailer	0.45

c. Description: excavate slot for HAWK command post platoon.

d. Additional information: none.

17. Construct vehicle trench (communications).[112]

a. Required information: number of vehicle trenches (50-m long); location.

b. Resource requirements per vehicle trench using one of two classes of equipment:

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[111] *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.

[112] *EFOSS*, N-III-y-1 through N-III-y-4; *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.

(1) D7 Dozer, ACE, or CEV

Equipment hr:

- D7 dozer, ACE, or CEV	0.84
- Two 2.5 cu yd scoop loader @ 0.84 hr	1.68
- M916 tractor w/trailer (D7 only)	0.84

(2) T5 Dozer

Equipment hr:

- T5 dozer	1.26
- Two 2.5 cu yd scoop loader @ 1.26 hr	2.52
- M916 tractor w/trailer	0.63

c. Description: excavate a trench to provide a vehicle route protected on both sides from enemy small arms fire and artillery shell fragments. The estimate is based on 50 m of trench.

d. Additional information: trench is assumed to be rectangular with a trapezoidal-shaped parapet on each side. The parapet is assumed to be 1 m wide at the top and 1 m high. Trench dimensions are depth, 1.8 m, and width, 3.5 m.

18. Construct shelter for command and communications facilities.[113]

a. Required information: number of shelters; location.

b. Resource requirements per shelter for one of two types of construction:

(1) Log Frame

(a) Squad hr: 14.7.

(b) Equipment hr:

- One 2.5 cu yd scoop loader	7.00
- Three 5-ton vehicles @ 7.0 hr	21.00
- One air compressor	7.00

(c) Total logistical weight: none.

(2) Aluminum Frame

(a) Squad hr: 15.1.

(b) Equipment hr:

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[113] *EFOSS*, pp N-III-z-1 through N-III-z-13; *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.

- One 2.5 cu yd scoop loader	6.50
- Three 5-ton vehicles @ 6.5 hr	19.50
- One air compressor	6.50

(c) Logistics:

Aluminum frame shelter kit	1 ea

Total weight: 0.48 MT.

c. Description: consists of cut and cover shelter suitable as a command post or tactical operations center bunker and covered with waterproofing material and 0.46 m of earth.

d. Additional information: For the log frame, interior dimensions are 2.4 by 3.4 m. The interior height is 2.1 m. The frame sides will not be sheathed; instead, tree branches will be wedged between earth sides of the excavation and frame to support the tar roofing, rolled material, and spoil cover. The roof is assumed to be covered with logs. Spaces between the roof logs will be chinked with sticks and branches to provide a cushion and a smooth, even surface upon which the plastic or waterproof tar roofing layer can rest. The aluminum frame interior dimensions are 2.7 by 3.7 m and the inside height is 2.0 m.

19-76. Dig in a maneuver unit given a TOE.

a. Required information: maneuver unit's TOE task number; percentage of fighting vehicles to be dug in; percentage of support vehicles to be dug in; percentage of work to be accomplished by each type of equipment used to dig the unit in (D7, ACE, CEV, or T5 dozer).

b. Resource requirements per position using one of two classes of equipment:

(1) D7 Dozer, ACE, or CEV

Equipment hr: Sum the blade hours calculated in paragraphs (a) through (g) below and multiply that figure by the percentage of work to be done by D7 dozers, ACEs, and CEVs. M916 tractor hours are equal to D7 dozer hours.

(a) Tanks Multiply the total number of tanks by the percentage of fighting vehicles to be dug in and by 1.50 blade hr/vehicle.

(b) M2/M3 fighting vehicles. Multiply the number of M2/M3 fighting vehicles by the percentage of fighting vehicles to be dug in and by 1.20 blade hr/vehicle.

(c) M113 series carriers. Sum the number of M113 chassis vehicles to include Improved TOW Vehicles, Mortar carriers, and Vulcans. Multiply this figure by the percentage of fighting vehicles to be dug in and by 0.70 blade hr/vehicle.

(d) Howitzers, SP 8-in./155-mm. Sum the number of self propelled

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EFOSS: *U.S. Army Engineer Assessment, Europe* (U), Vol II, Figure B-1-11.

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howitzers. Multiply this figure by the percentage of fighting vehicles to be dug in and by 2.50 blade hr/position. Note: these positions include room for protecting for the ammo carriers.

(e) Howitzers, 155-mm or 105-mm towed. Sum the number of 155-mm and 105-mm towed howitzers. Multiply this figure by the percentage of fighting vehicles to be dug in and by 0.30 blade hr/position to find the blade hours required to dig in all towed howitzer protective positions.

(f) M577 CP carriers. Multiply the number of command post carriers by the percentage of support vehicles to be dug in and by 0.80 blade hr/vehicle.

(g) Noncombat tracked and wheeled vehicles. Sum the number of noncombat vehicles. Multiply this figure by the percentage of support vehicles to be dug in and by 1.50 blade hr/vehicle.

(2) Airborne/Airmobile earthmoving equipment (T5 Dozer)

Equipment hr: Sum of the blade hours calculated in paragraphs a through g below to find the total T5 dozer hours. M916 tractor hours and equal to one half the T5 hours.

(a) Tanks Multiply the total number of tanks by the percentage of fighting vehicles to be dug in and by 2.25 blade hr/vehicle.

(b) M2/M3 fighting vehicles. Multiply the number of M2/M3 fighting vehicles by the percentage of fighting vehicles to be dug in and by 1.80 blade hr/vehicle.

(c) M113 series carriers. Sum the number of M113 chassis vehicles to include Improved TOW Vehicles, Mortar carriers, and Vulcans. Multiply this figure by the percentage of fighting vehicles to be dug in and by 1.05 blade hr/vehicle.

(d) Howitzers, SP 8-in./155-mm. Sum the number of self propelled howitzers. Multiply this figure by the percentage of fighting vehicles to be dug in and by 3.75 blade hr/position. Note: these positions include room for protecting for the ammo carriers.

(e) Howitzers, 155-mm or 105-mm towed. Sum the number of 155-mm and 105-mm towed howitzers. Multiply this figures by the percentage of fighting vehicles to be dug in and by 0.45 blade hr/position to find the blade hours required to dig in all towed howitzer protective positions.

(f) M577 CP carriers. Multiply the number of command post carriers by the percentage of support vehicles to be dug in and by 1.20 blade hr/vehicle.

(g) Noncombat tracked and wheeled vehicles. Sum the number of noncombat vehicles. Multiply this figure by the percentage of support vehicles to be dug in and by 2.25 blade hr/vehicle.

c. Description: these tasks calculate the effort required to dig in a specified percentage of vehicles for a given maneuver unit. Resources are for digging only one position per vehicle. The task can be repeated to calculate the effort for secondary and alternate positions for combat vehicles.

d. Additional information: the type and number of vehicles assigned to a maneuver unit with a given TOE can be found in Appendix B. The task number for a given TOE is listed below:

19. ANTIARMOR CO, INF BN (M) ITV, 01OCT82, 07248J400
20. ARMD CAV REGT, 01APR84, 17051J330
21. ARMD CAV REGT, E/W M1/M3, 01APR84, 17051J320
22. ARMD CAV REGT, W/M60/M113/ITV, 01APR84, 17051J320
23. ARMD CAV SQDN, ARMD CAV REGT, 01APR84, 17055J330
24. ARMD CAV SQDN, ARMD CAV REGT, 01APR84, 17055J310
25. ARMD CAV SQDN, ACR, M1/M3, 01APR84, 17055J320
26. ARMD CAV TRP, ARMD CAV REGT, 30NOV70, 17058H000
27. ARMD CAV TRP, ARMD CAV REGT, 30NOV70, 17058H020
28. ARMD CAV TRP, AC SQDN, M113/M60, 01APR84, 17057J310
29. ARMD CAV TRP, AC SQDN, M1/M3, 01APR84, 17057J320
30. CSC, INF BN (MECH), W/106, 30NOV70, 07048H010
31. CSC, INF BN MECH-18 TOW, 30NOV70, 07048H030
32. CSC, INF BN MECH-12 TOW, 30NOV70, 07048H020
33. FA BN, 105-mm T, INF DIV, 20APR79, 06155H000
34. FA BN, 155 SP HVY DIV, 01OCT82, 06365J410
35. FA BN, 155 SP HVY DIV, 01OCT82, 06365J420
36. FA BN, 155 SP HVY DIV, 01OCT82, 06365J430
37. FA BN, 155-mm/8-in., INF DIV, 20APR79, 06165H000
38. FA BN, 8 in./MLRS HVY DIV, 01OCT82, 06395J200
39. FA BTRY, 155 SP HVY DIV, 01OCT82, 06367J410
40. FA BTRY, 155-mm T, FA BN, 09AUG78, 06167H000
41. FA BTRY, 8-in. SP HVY DIV, 01OCT82, 06397J200
42. FA BTRY, FA BN, 8-in. SP, 09AUG78, 06358H000
43. HHB 8-in./MLRS BN HVY DIV, 01OCT82, 06396J200
44. HHB, 155 T/8-in. SP, FA BN, 20APR79, 06166H000
45. HHB, FA BN, 105-mm TOWED, 20APR79, 06156H000
46. HHB, FA BN, 105-mm TOWED, 09AUG78, 06157H000
47. HHB, FA BN, 155 SP HVY DIV, 01OCT82, 06366J410
48. HHB, FA BN, 155 SP HVY DIV, 01OCT82, 06366J420
49. HHB, FA BN, 155 SP HVY DIV, 01OCT82, 06366J430
50. HHC, INF BN (MECH), 30NOV70, 07046H010
51. HHC, INF BN (MECH), 30NOV70, 07046H020
52. HHC, INF BN MECH BFVS, 01APR83, 07246J410
53. HHC, INF BN MECH M113, 01APR83, 07246J420
54. HHC, TK BN, M60, 01OCT81, 17236J1110
55. HHT, ARMD CAV REGT, 01APR84, 17052J310
56. HHT, ARMD CAV REGT, 01APR84, 17052J320
57. HHT, ARMD CAV SQDN, 01APR84, 17056J310
58. HHT, ARMD CAV SQDN, 01APR84, 17056J320
59. HHT, ARMD CAV SQDN, 01APR84, 17056J330

60. INF BN (MECH) E/W 106, 30NOV70, 07045H010
61. INF BN E/W 12 TOW, 30NOV70, 07045H020
62. INF BN E/W 18 TOW, 30NOV70, 07045H030
63. INF BN-MECH E/W BFVS, 01APR83, 07245J410
64. INF BN-MECH E/W M113, 01APR83, 07245J420
65. RIFLE CO, INF BN MECH M113, 01OCT82, 07247J420
66. RIFLE CO, INF BN, (MECH), 30NOV70, 07047H010
67. RIFLE CO INF BN, (MECH), 30NOV70, 07047H020
68. RIFLE CO, INF BN, MECH BFVS, 01OCT82, 07247J410
69. SVC BTRY, 155 SP HVY DIV, 01OCT82, 06369J410
70. SVC BTRY, 155-mm T/8 in. SP, 30NOV70, 06169H000
71. SVC BTRY, 8 in./MLRS HVY DIV, 01OCT82, 06399J200
72. SVC BTRY, FA BN, 105-mm TOWED, 20APR79, 06159H000
73. TK BN, EQ W/M1, 01APR84, 17235J420
74. TK BN, EQ/W M60, 01APR84, 17235J410
75. TK CO, (M1), 01APR84, 17237J420
76. TK CO, TK BN M60, 01APR84, 17237J410

Note: Additional TOE's can be added from the utilities menu "Edit Unit's TOE" function.

LIST OF ABBREVIATIONS

ABN: airborne
ABT: abatis
AC: armored calvary
ACE: armored combat excavator
ACR: armored cavalry regiment
ADAM: area denial artillery munition
AFT:
AMBL: air mobile
Ammo: ammunition
AP: antipersonnel
APB: antipersonnel, blast
APC: armored personnel carrier
APF: antipersonnel, fragmentary
ARMD: armored
ARTY: artillery
AT: antitank
ATD: antitank ditch
AVLB: armored vehicle launched bridge
BN: battalion
BFVS: Bradley fighting vehicle system
BRA: blow major four-lane highway bridge
BRB: blow primary highway bridge
BRC: blow secondary two-lane highway bridge
CEM3: Combat Engineer Mission Management Module
CEV: combat engineer vehicle
CHAPARRAL (M48): Low-altitude, surface-to-air, self-propelled missile system; chassis is an M730 tracked carrier similar to an M548 cargo carrier.
CO: company
Commo: communications
CP: command post
CSC: combat support company
CWAR: continuous wave acquisition radar
DIV: division
EFOSS: Engineer Family of Systems Study
FA: field artillery
FAAR: forward area alerting radar
FM: field manual
GATOR: USAF delivered scatterable mines
GEMSS: Ground-Emplaced Minefield Scattering System
GPBTO: general-purpose barbed-tape obstacle
HAWK: Homing All the Way Killer (antiaircraft missile system)
HIPIR: high-powered illuminator radar
HQDA: Headquarters, Department of the Army
HVY: heavy
INF: infantry
IOE: irregular outer edge
Info: information
ITV: improved TOW vehicle
MH: manhours
MECH: mechanized

MFAF: GATOR (USAF Delivered Scatterable Mines)
MFAT: RAAMS artillery delivered AT minefield
MFAP: ADAM artillery delivered AP minefield
MFD: M57 AT mine dispensing system
MFGT: minefield, GEMSS, AT only
MFGP: minefield, GEMSS, AP only
MFGM: minefield, GEMSS, mixed AT and AP
MFH: M56 helicopter delivered AT mines
MFJ: standard minefield, density .5-.5-1
MFK: standard minefield, density 1-1-1
MFMT: minefield, MOPMS, AT
MFMP: minefield, MOPMS, AP
MLRS: multiple launched rocket system
MOPMS: modular pack mine system
MSR: main supply route
MT: metric ton
PAR: pulse acquisition radar
PLT: platoon
RAAMS: remote antiarmor mine system
RCD: deliberate road crater
RCH: hasty road crater
RCM: road crater with M180
REGT: regiment
ROR: range-only radar
SEE: small emplacement excavator
SLUFAE: surface air explosives
SP: self-propelled
SQ: squad
SQDN: squadron
T: towed
TNT: trinitrotoluene (dynamite)
TOE: table of organization and equipment
TOW: tube-launched, optically-tracked, wire-guided
TRP: troop
USAES: United States Army Engineer School
WBT: general-purpose barbed-tape obstacle
WF: 36WF160: 36 inch deep I-beam, wide flang, 160 lbs per linear foot
WRC: nonstandard concertina roadblock
WTC: triple standard concertina
VULCAN: M163 20-mm Vulcan self-propelled antiaircraft gun: chassis is an M741 armored carrier similar to the M113 APC.

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